Bulletin 102

DEPARTMENT OF THE INTERIOR

FRANKLIN K. LANE, SECRETARY

BUREAU OF MINES

VAN. H. MANNING, DIRECTOR

THE INFLAMMABILITY OF ILLINOIS COAL DUSTS

BY

J. K. CLEMENT AND L. A. SCHOLL, JR.

ILLINOIS COAL-MINING INVESTIGATIONS
COOPERATIVE AGREEMENT

[This report was prepared under a cooperative agreement with the Illinois State Geological Survey and the department of mining engineering of the University of Illinois.]

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THE INFLAMMABILITY OF ILLINOIS COAL DUSTS.

By J. K. Clement and L. A. Scholl, Jr.

INTRODUCTION.

Among the problems investigated by the Bureau of Mines the coal-dust problem has received much attention. Several of the bureau's publications deal specifically with the subject. Bulletin 20[a] contains an account of preliminary experiments of the bureau to determine the explosibility of coal dusts as well as a review of pertinent literature. Bulletin 50[b] is a report of a laboratory study of the inflammability of coal dust. The first series of coal-dust explosion tests in the bureau's experimental mine at Bruceton, Pa., is described in Bulletin 56[c], and Technical Paper 56[d] presents notes on the prevention of dust and gas explosions in coal mines, and Technical Paper 84[e] discusses the causes of such explosions and describes methods and apparatus devised by engineers of the bureau for preventing and checking them.

The present paper is a report of a detailed study of the bituminous dusts of Illinois mines, and is a part of the investigations conducted by the bureau in cooperation with the Illinois State Geological Survey and the department of mining engineering of the University of Illinois.[f]

It is well known that bituminous coals like those found in Illinois yield dusts that may give rise to explosions of great violence. In order that proper methods might be devised for preventing dust explosions in Illinois mines it was considered desirable to obtain accurate information on the quantity and character of these dusts. Experiments and tests of dust explosions in an experimental mine as

[a] Rice, G. S., The explosibility of coal dust with chapters by J. C. W. Frazer, Axel Larsen, Frank Haas, and Carl Scholz. 204 pp.

[b] Frazer, J. C. W., Hoffman, E. J., and Scholl, L. A., jr., A laboratory study of the inflammability of coal dust. 1913. 60 pp.

[c] Rice, G. S., Jones, L. M., Clement, J. K., and Egy, W. L., First series of coal-dust explosion tests in the experimental mine. 1913. 115 pp.

[d] Rice, G. S., Notes on the prevention of gas and dust explosions in coal mines. 1913. 24 pp.

[e] Rice, G. S., and Jones, L. M., Methods of preventing and limiting explosions in coal mines. 1915. 50 pp.

[f] A statement of the plan of organization and of the scope of the work being carried on under the cooperative agreement is contained in the "Preliminary Report on Organization and Method of Investigations, Illinois Coal Mining Investigations Cooperative Agreement," University of Illinois, Urbana, 1913.

well as in a large steel gallery comparable in area of cross section to mine entries have been made by the Bureau of Mines. Similar experiments have been made in Austria, England, France, and Germany. Experiments under conditions similar to those of actual mining practice are obviously more conclusive than tests made in a laboratory. On account, however, of the expense, time, and quantity of dust required, it is not practicable to conduct large-scale tests in studying a large number of dusts and recourse must be had to laboratory apparatus and methods.

Laboratory devices for the study of coal-dust explosions have been devised by a number of investigators. Most of these were intended for qualitative tests only. Quantitative methods have been devised by investigators of the English and French mining-experiment stations.[a] In the experiments described in this report, laboratory tests of inflammability were made with an apparatus devised by Dr. J. C. W. Frazer,[b] formerly a chemist of the Bureau of Mines.

Laboratory tests of inflammability have been made on more than 500 samples of dust from 100 representative Illinois mines. As a result of these tests it may be stated that:

1. The coals of Illinois when ground fine enough yield highly inflammable dusts which when suspended in air may give rise to violent explosions.

2. In the majority of the mines of the State the dusts adhering to the ribs are inflammable. In about one-fourth of the mines the quantity of rib dusts present in the entries is sufficient to form an explosive mixture with air.

3. Most of the road dusts are inflammable when ground to a sufficient degree of fineness.

METHODS OF COLLECTING DUST SAMPLES.

The dust samples were collected by mining engineers of the University of Illinois and of the Bureau of Mines. Preliminary preparation of the samples and moisture determinations were made at Urbana, Ill., under the direction of Prof. S. W. Parr, by J. W. Lindgren and F. C. Whithen. The dust laboratory was equipped by the mining department of the University of Illinois, and the inflammability tests were made by L. A. Scholl, jr., junior chemist of the Bureau of Mines, and G. W. Porter of the mining department of the university, under the direction of Messrs. Frazer and Clement of the Bureau of Mines.

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[a] Taffanel, J., and Durr, A., Cinquième série d'essais sur les inflammations de poussières; Essais d'inflammabilité, 1911, 70 pp.; Taffanel, J., Note sur des expériences relatives au classement des gisements de poussières, 1912, 15 pp; Second Report to the Secretary of State for the Home Department of the Explosions in Mines Committee, London, 1912, 43 pp.

[b] See Frazer, J. C. W., Hoffman, E. J., and Scholl, L. A., jr., A laboratory study of the inflammability of coal dust: Bull. 50, Bureau of Mines, 1913, pp. 5–7.

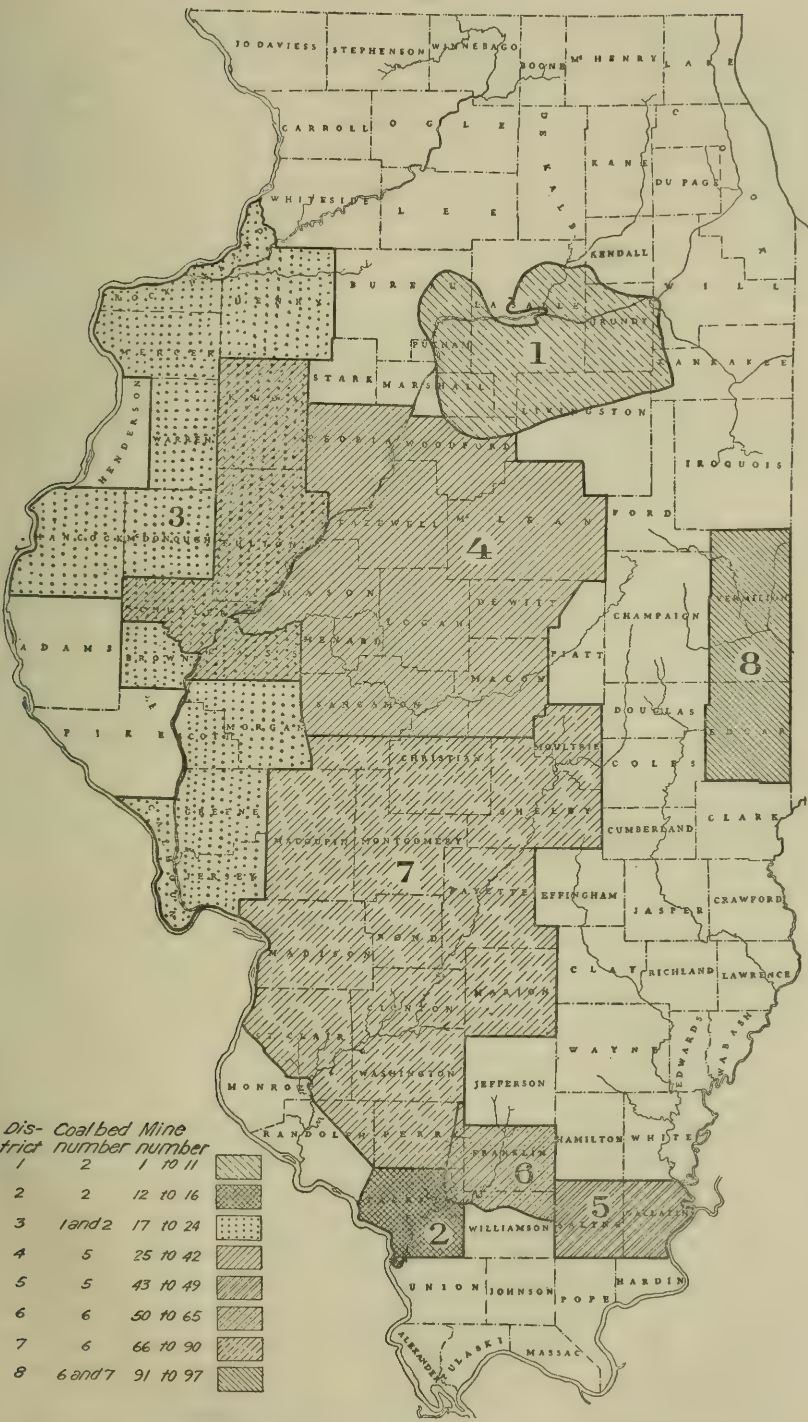


FIGURE 1.—Map of Illinois showing districts into which State was divided for investigation.

For the purposes of the cooperative mining investigation the State was divided into eight districts, the mines working the same seam being grouped as far as possible. The boundaries of the districts are shown in figure 1. In the eight districts 100 representative shipping mines were chosen for examination. Figure 2 shows the principal workable coal seams in the State. Inasmuch as the 100 representative mines selected for examination represent 25 per cent of the mines of the State that ship coal, it is thought that any generalizations and conclusions based on results obtained in a study of those mines should be representative of all the mines of the State.

COLLECTION OF FACE SAMPLES.

The method of sampling was essentially the same as the method described in Bureau of Mines Technical Paper 1.[a] One difference was that the sample cut from the face was ground in a special grinder to ⅛-inch size or smaller. After the sample had been ground, it was reduced by means of a mechanical riffle to a sample weighing 3 to 5 pounds, which was placed in an air-tight can with a screw cap. The cap was wound with tape as an additional safeguard against deterioration of the sample. It was thought that the use of the special grinder and the riffling device would eliminate in part at least the personal equation. Three face samples were taken in the same manner from three places in each mine, and at some of the more important mines, and at least at one mine in each district, six face samples were taken at different points in order to ascertain the variations or uniformity in the chemical composition of the coal in the particular mine and bed of coal.

The inflammability tests were conducted as soon as possible after the receipt of the sample at Urbana. This precaution was deemed advisable because previous investigations had shown that Illinois coals lose inflammable gases during the first two weeks after mining.[b]

Before an inflammability test was made the sample was subjected to the following preliminary treatment: The sample after removal from the container was placed in a shallow tray, weighed, placed in a drying oven, and dried at a temperature of about 35° C. to constant weight, a current of air being forced over the tray of coal by a small fan. The sample was then ground fine in a grinder similar to the one employed in the mine, reduced by riffling to a sample of about 500 grams, and passed through a 60-mesh sieve. Two small 60-gram samples of this 500-gram sample of 60-mesh coal were placed in separate bottles, one sample for analysis and one for inflammability tests. The rest of the 500-gram sample was placed in an air-tight glass fruit jar as a reserve sample. From the three individual face

[a] Holmes, J. A., The sampling of coal in the mine: Tech. Paper 1, Bureau of Mines, 1911, 18 pp.

[b] Parr, S. W., and Barker, Perry, The occluded gases in coal: University of Illinois, Bull. 32, 1909, p. 27.

FIGURE 2.—Map of Illinois showing coal beds.

samples to be used in the inflammability tests a composite sample was made, 15 grams being taken from each 60-gram sample by quartering after a thorough mixing. The composite sample was then ground to pass through a 200-mesh sieve, placed in a bottle, and labeled. As soon as possible after grinding, the inflammability tests of the finely ground sample were made. In addition to the composite samples from each mine, general composite samples for each district were made by taking a definite quantity, usually 5 grams, from the finely ground individual composite samples.

In this report for convenience the coal beds are designated as "No. 1," "No. 2," etc., after the practice of the Illinois State Geological Survey. The equivalent designations adopted by the United States Geological Survey are given below:

Number as used by State geological survey.	Designation adopted by United States Geological Survey.
No. 1	No. 1; term is applied to several discontinuous beds.
No. 2	Murphysboro.
No. 3	Harrisburg, except in Springfield and Peoria districts, where designation is Springfield.
No. 6	Herrin (displaces term "Belleville").
No. 7	No. 7.

COLLECTION OF MINE-DUST SAMPLES.

The mine dusts collected comprised two kinds—rib dusts and road dusts. The rib-dust samples were gathered from the ribs of the entries and rooms, and the road-dust samples were collected from the floors of the entries.

The rib-dust samples were taken at three different points in each mine, as follows: Sample 3 on the main haulage entry, sample 2 on the secondary haulage entry, and sample 1 inside the last crosscut near the face of the entry or from a room. The method employed in obtaining the samples was as follows: A chalk line was drawn from the roof to the floor and the dust was brushed from the rib onto a sheet of clean paper with a 1-inch varnish brush until sufficient dust was obtained to fill a 40-gram glass bottle. The sample was immediately transferred to the bottle, which was closed with a rubber stopper. The height and the width of the rib brushed were measured in order to have an estimate of the amount of rib dust present in the entries throughout the mine, and the relative humidity and the volume of air from the intake were observed.

Samples of road dust were taken at two different points in each mine—one (sample 2) on the main haulage entries near the point at which the corresponding rib-dust sample was taken; the other

(sample 1) on the secondary haulage entries at a place near the point at which the corresponding rib-dust sample was obtained. A section of entry about 100 feet long was selected for sampling, the place where the rib-dust sample was taken being about the middle of this distance. With a small metal spatula, a series of samples approximating about 1 ounce for each 3 feet of entry were taken. The dust collected in this manner was placed in a metal can provided with a screw cap and having a minimum capacity of 3 pounds. The cap was wound with tape as an extra precaution, and the can was forwarded to the laboratory.

PRELIMINARY TREATMENT OF MINE-DUST SAMPLES.

As the treatment of the road-dust and of the rib-dust samples in the laboratory preliminary to the inflammability determinations was the same, it is discussed under one heading. Upon the receipt of cans of road dust and bottles of rib dust at the laboratory, they were opened and the dust air dried on a tray in the drying oven at a temperature of 35° C. until a constant weight was obtained and the loss in weight determined. Each dust sample was separated into parts by being screened with 20, 60, 100, and 200 mesh sieves and the several parts were weighed.

In inflammability tests of rib and road dusts three classes of samples were used, as follows: (1) The part of the air-dried sample passing through a 20-mesh sieve; (2) the part passing through a 200-mesh sieve; (3) samples prepared from the part of the air-dried sample that passed the 20-mesh sieve after grinding to pass a 200-mesh sieve.

It might well be expected that the inflammability of an air-dried sample of dust would be different from that of a sample containing its original moisture. Experiments have shown that although as a rule the air-dried sample develops slightly higher pressure than the "as-received" sample the difference is negligible.

METHOD OF ANALYZING DUST SAMPLES.

Upon the completion of the inflammability tests of a sample of dust it was immediately shipped to the Bureau of Mines testing station at Pittsburgh, where analyses were made under the direction of A. C. Fieldner, chemist. Ultimate analyses and calorimeter tests were made of the face samples, but proximate analyses and calorimeter tests only were made of the road and rib dusts.

PROXIMATE ANALYSIS.

Moisture.—A 1-gram sample of fine coal in a porcelain capsule is heated for 1 hour at 105° C. in a constant-temperature oven through which dry air is circulated. The figure representing loss in weight

multiplied by 100 represents the percentage of moisture in the sample of air-dried coal.

Volatile matter.—A 1-gram sample of fine coal is heated to a temperature of 950° C. in a 10 c. c. platinum crucible with a platinum capsule cover in an especially designed electric furnace for 7 minutes.[a] The loss in weight from heating less the weight of the moisture determined at 105° C. multiplied by 100 gives the percentage of volatile matter in the sample.

Ash.—The porcelain capsule containing the residue from the moisture determinations is placed in a muffle furnace and heated slowly, the volatile matter being driven off; finally the temperature is raised to 750° C., and heating is continued until the weight becomes constant. The weight of the residue in the crucible is the ash or ignited mineral matter in the coal, which, multiplied by 100, gives the percentage of ash in the coal.

Sulphur.—The sulphur is determined by the Eschka method of heating 1 gram of the fine coal with 2 grams of "Eschka mixture" (MgO 2 parts and Na_2CO_3 1 part) in a 40 c. c. porcelain crucible. The crucible is heated slowly at first to avoid losses, the heat being raised until all black particles have been consumed. After digestion with hot water, filtration, acidification with HCl, and addition of bromine water, the sulphur, which is in the form of the sulphate, is precipitated as barium sulphate, filtered, ignited, and weighed. The weight of barium sulphate multiplied by 13.74 gives the percentage of sulphur in the sample.

Fixed carbon.—The difference between the sum of the percentages of the moisture, ash, and volatile matter in a sample of fine coal and 100 is called the percentage of fixed carbon in the sample.

ULTIMATE ANALYSIS.

Carbon and hydrogen. The percentages of carbon and hydrogen in a sample of fine coal are determined by the combustion method, whereby the carbon and the hydrogen are converted to carbon dioxide and water, respectively, and, after absorption by a suitable medium each is determined by the increase in weight of the absorbing medium. A sample weighing 0.2 gram is employed. Calcium chloride is used to absorb the water formed by the combustion, and the increase in weight of the calcium chloride tube multiplied by 55.95 equals the percentage of hydrogen in the sample. Potassium hydroxide is used to absorb the carbon dioxide found as a result of the combustion, and the increase in weight of the potassium hydroxide bulbs multiplied by 136.36 gives the percentage of carbon in the sample.

[a] See Fieldner, A. C., Notes on the sampling and analysis of coal: Tech. Paper 76, Bureau of Mines, 1914, p. 20.

Nitrogen.—For determining the nitrogen content of the sample of fine coal the Kjeldahl-Gunning method is employed. The nitrogen in a 1-gram sample is converted to ammonium sulphate by boiling a mixture of the coal, concentrated sulphuric acid, potassium sulphate, and a drop of mercury in a round-bottomed flask. After treatment to precipitate the mercury and take care of the excess acid, the solution is made alkaline with NaOH and the ammonia is distilled into a measured amount of standard sulphuric-acid solution to which cochineal indicator has been added. The nitrogen content of the sample is then calculated after the excess sulphuric acid has been titrated with a standard solution of NH_4OH.

Calorific value.—The calorific value of the fine coal is determined by means of the Mahler bomb calorimeter. One gram of coal is burned in the bomb. From the rise in temperature of the calorimeter system the heating value of the coal dust is calculated.

For a complete description of the methods and the apparatus employed in analyzing the dusts the reader is referred to Technical Paper 8 of the Bureau of Mines[a].

CHARACTER AND OPERATION OF APPARATUS USED IN TESTS.

The equipment of the laboratory is shown in Plate I, *A*. The electric current for the heating coil was furnished by a motor generator giving direct current at 110 volts and provided with a voltage regulator.

DESCRIPTION OF APPARATUS.

The inflammability apparatus used in the investigations is shown in Plate I, *B*, and figure 3.

The apparatus consists of an explosion flask, a device for putting the dust in suspension, a platinum ignition coil, and a device for measuring the pressure developed in the explosion flask.

The explosion flask *a* (fig. 3) is made of heavy glass with a low coefficient of expansion, and has a capacity of 1,500 c. c. At the top and the bottom are large tubulures which are ground true. A wide rubber band placed around the lower tubulure, and extending a short distance below it, contracts over the end of the tubulure so as to form a cushion between the tubulure and the brass plate *c*. A rubber gasket is cemented to the under side of the brass plate *k*, where it rests on the upper tubulure. By this means, when the nuts above the steel piece *l* are screwed down, the joints at the top and the bottom of the flask are made gas tight.

The dust injector consists of a small glass funnel, *b*, cemented into the brass plate *c*. A piece of 30-mesh copper gauze covers the top

[a] Stanton, F. H., and Fieldner, A. C., Methods of analyzing coal and coke: Tech. Paper 8, Bureau of Mines, 1913, 42 pp.

of the funnel and serves to break up the dust into a cloud when the dust is ejected from the funnel into the flask by the release of the compressed air contained in the 150 c. c. glass bulb *d*. The igniter *i* consists of a coil of 100 cm. of No. 26 platinum wire wound upon quartz insulators which are attached to the heavy nickel leads, *j*. The nickel leads pass the wooden bushings in the top brass plate and hold the coil in the center of the explosion flask. The ends of the platinum wire are soldered with silver to the nickel leads.

The device used to measure the pressure developed in the flask comprises a small 50 c. c. flask, *q*, containing a weighed amount of mercury, and a small steel ball, *n*, which is ground to fit practically

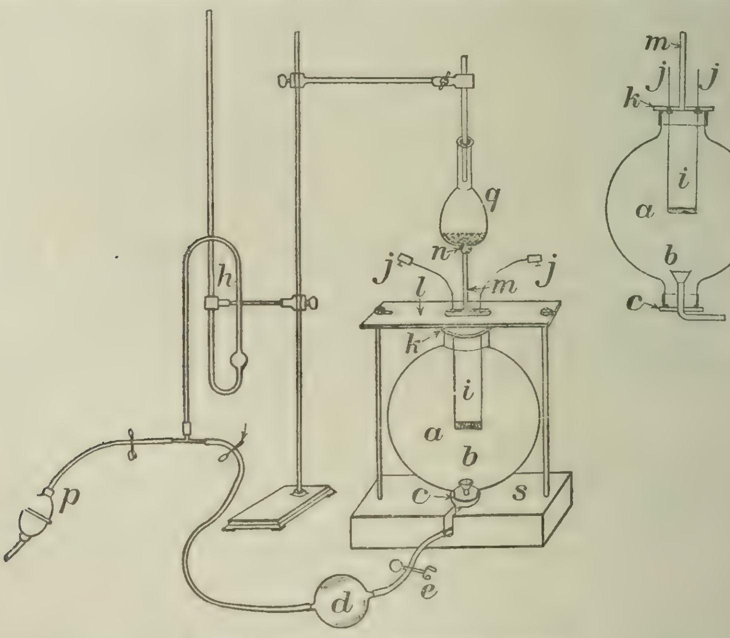


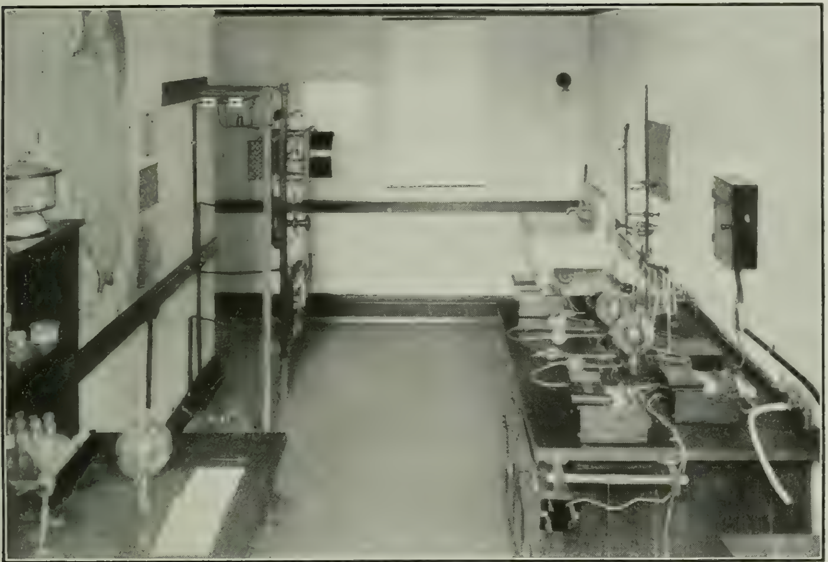
FIGURE 3. Diagram of inflammability apparatus.

gas-tight into the brass tube *m*, which communicates through *k* with the large flask *a*.

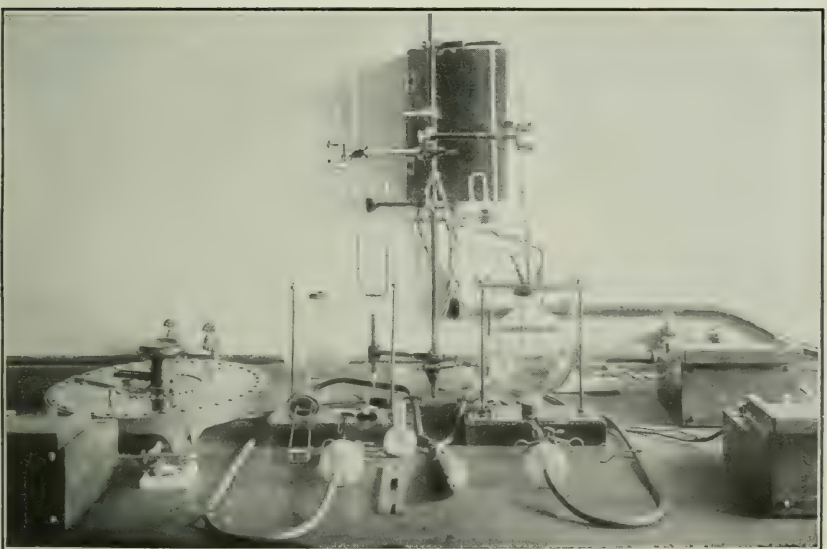
OPERATION OF APPARATUS.

A weighed amount of dust (0.05 gram) is placed in the funnel, which is then connected to the bulb *d* by means of a short piece of rubber tubing closed with a pinch cock, *e*, and placed in a shaped receptacle in the wooden block *s*. By means of the compression bulb *p* the air in *d* is compressed to a pressure of 200 mm. of mercury as indicated by the manometer *h*.

With the apparatus assembled as shown in Plate I, *B*, the desired current is passed through the platinum coil for exactly 3 minutes, and



A. EQUIPMENT OF LABORATORY AT URBANA, ILL.



B. INFLAMMABILITY APPARATUS AND ACCESSORIES.

during that interval the expanding air in the flask *a* (fig. 3) is released by the lifting of the steel ball *n* at intervals of 1, 2, and 2¾ minutes. At the expiration of the third minute the pinch cock is opened and the dust in the funnel is blown into the flask. To prevent release of pressure through *b* it has been found desirable to introduce a check valve.

The experiment is repeated, the weight of mercury being varied each time until the pressure lies between two weights 5 grams apart. The mean of the two values is then accepted as the maximum pressure that each dust being studied is able to produce at the temperature used. The maximum pressure that each dust will develop is determined in the above manner for five different temperatures—800°, 900°, 1,000°, 1,100°, and 1,200° C. In all the experiments 0.05 gram of dust is used, and the resultant pressure checks consistently if identical conditions are maintained for all experiments. It is essential to have a steady current, and for this purpose an ammeter is always in circuit, the current being regulated closely by means of a rheostat.

CALIBRATION OF PLATINUM COIL.

As the character of the explosion and the pressure developed by it depend on the temperature of the platinum coil or grid, the determination of this temperature is important. The temperature is calculated from the electrical resistance of the wire as measured by the fall-of-potential method. To determine the temperature-resistance curve of the platinum wire, the wire is wound on a porcelain tube and heated in an electric furnace, the resistance being measured by a Wheatstone bridge. The temperature is measured by a thermocouple whose hot junction is in the axis of the porcelain tube midway between the ends of the platinum spiral. Proper corrections are made for the resistance of the leads.

On account of the cooling effect of the leads the temperature of the platinum coil is greater in the middle than at the ends, and the temperature determined by the resistance of the wire is somewhat below the actual temperature of the middle part of the coil.

The coating of ash deposited on the wire by the coal dust produces a change in the electrical resistance of the wire as well as in the radiating surface. From time to time the wire is cleaned by removing it from the grid and immersing it in hydrofluoric acid. The change in the resistance of the wire occasioned by impurities as well as by variations in the dimensions of the wire was so rapid that it is found necessary to verify the temperature-resistance curve once a day. Verification is accomplished by determining the resistance of the coil at the so-called "critical temperature" for Pittsburgh standard dust. The resistance of the coil at the critical temperature and the temperature coefficient of the wire being known, the corrections to the temperature-resistance curve are readily calculated.

INFLAMMABILITY DETERMINATIONS WITH DIFFERENT TYPES OF COAL.

The pressures produced by the combustion of different dusts varies from zero to 10 pounds per square inch, depending on the chemical and physical properties of the dust and the temperature of the platinum wire. The results obtained with four typical coals are represented graphically in figure 4; and the results of analyses of the coals are given in the following table:

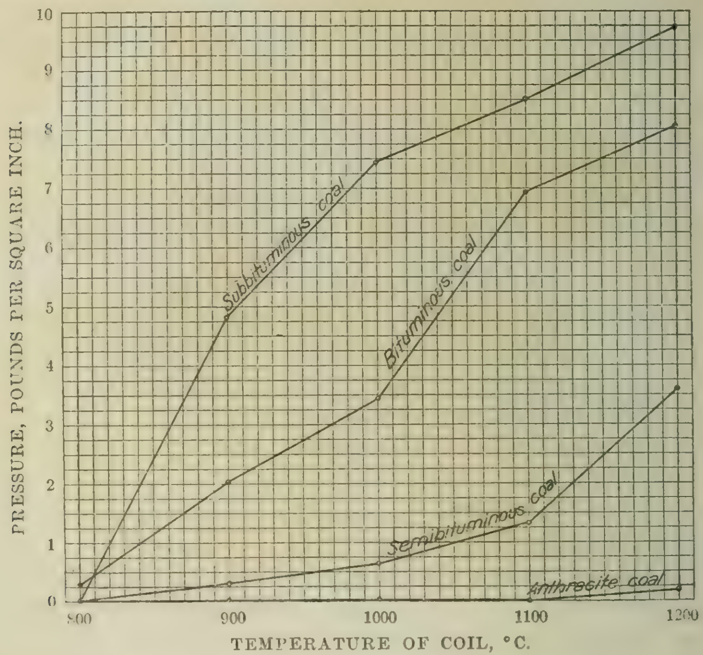


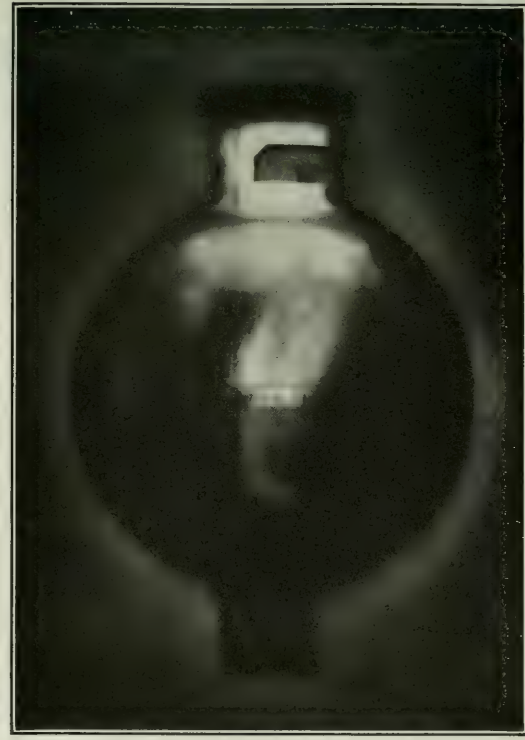
FIGURE 4.—Inflammability curves for four typical coals.

Results of analyses of samples of four typical coals.

Kind of coal.	Laboratory No.	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calorific value.
		P. cent.	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*B. t. u.*
Anthracite	15,000	1.58	6.82	80.40	11.20	0.74	2.70	81.03	1.01	3.32	13,124
Semibituminous	10,630	.51	18.41	77.40	3.68	.64	4.90	85.69	1.60	3.49	15,052
Bituminous	10,845	1.81	35.76	56.41	6.02	1.20	5.32	77.04	1.47	8.95	13,937
Subbituminous	10,822	13.94	35.12	45.44	5.50	.56	6.01	58.49	1.08	28.36	10,260

The pressure developed by the combustion of anthracite dust is so low as to be inappreciable even at high temperatures, and there is little if any combustion. The method of testing inflammability used in this investigation is not suitable for testing coals low in volatile matter and high in fixed carbon, but such coals are not found in Illinois. Subbituminous dust is distinguished from bituminous dust

A. APPEARANCE OF FLAME WITH PITTSBURGH STANDARD DUST; TEMPERATURE OF COIL 1,000° C.



B. APPEARANCE OF FLAME WITH PITTSBURGH STANDARD DUST; TEMPERATURE OF COIL 1,100° C.

A. APPEARANCE OF FLAME WITH PITTSBURGH STANDARD DUST; TEMPERATURE OF COIL 1,200° C.

B. APPEARANCE OF FLAME WITH DUST THROUGH 20-MESH AND OVER 40-MESH SCREEN; TEMPERATURE OF COIL 1,200° C.

not only by the higher pressures produced on combustion, but by the high pressures being developed at a much lower temperature. There are no subbituminous coals in Illinois. The ratio of volatile matter to fixed carbon of Illinois coals does not vary widely, so that the method of testing probably shows closely the relative inflammability when the ash and the moisture contents are not high.

INFLUENCE OF VARIOUS FACTORS ON INFLAMMABILITY CURVE.

The curve for the bituminous dust exhibits a characteristic common to all of the Illinois coals tested and to a large number of bituminous coals. With rise in temperature the pressure increases slowly at first up to a certain temperature, usually between 1000° and 1100° C., where the curve bends sharply upward and the pressure rises rapidly. After a small rise in temperature beyond this point the curve bends sharply to the right, and the increase in pressure with further rise in temperature is slight. The temperature at which the pressure curve

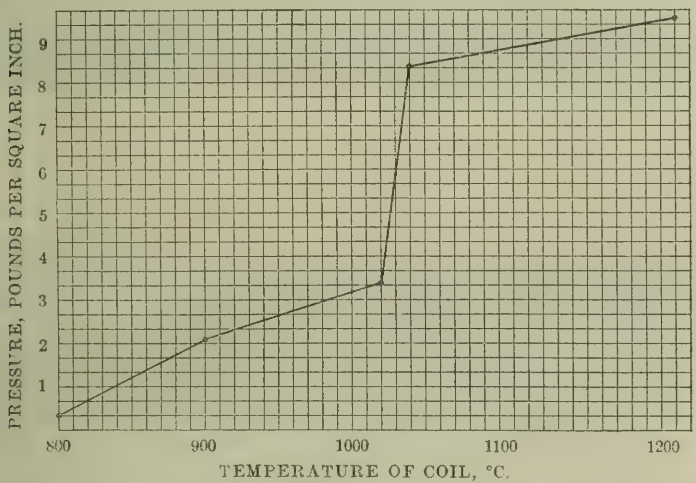


FIGURE. 5.—Inflammability curve for Pittsburgh standard dust with pressures determined at intervals of 20° between 1000° and 1100° C.

bends upward has in this report been termed by the authors the "critical temperature."

The exact shape of the inflammability curve for Pittsburgh standard dust in the vicinity of the critical temperature was determined by making tests at intervals of 20° between temperatures of 1000° and 1100° C. The results are represented graphically in figure 5.

The critical temperature seemingly marks the dividing line between combustion in the immediate vicinity of the coil at lower temperatures and a flame that is propagated throughout the dust cloud at higher temperatures. The difference in the character of the flame obtained with Pittsburgh standard dust at temperatures below and above the critical temperature is shown by figures Plate II, *A* and *B*,

and Plate III, *A*. Reference has been made (p. 17) to the practical value of the critical temperature of Pittsburgh standard dust as a point of reference for controlling the temperature of the platinum coil.

As previously stated, all the inflammability tests of face samples were made on samples ground to pass through a 200-mesh screen. The reason for adopting this practice is that the finer the dust the greater is its inflammability. The influence of the size of the dust particles on the phenomena taking place in the flask is shown by Plates III, *B*, IV, *A*, and *B*, and V, *A* and *B*, which are reproduced from photographs of the flames produced by various sized Illinois dusts.

The flame is propagated throughout the dust cloud only with dusts fine enough to pass a 200-mesh screen.

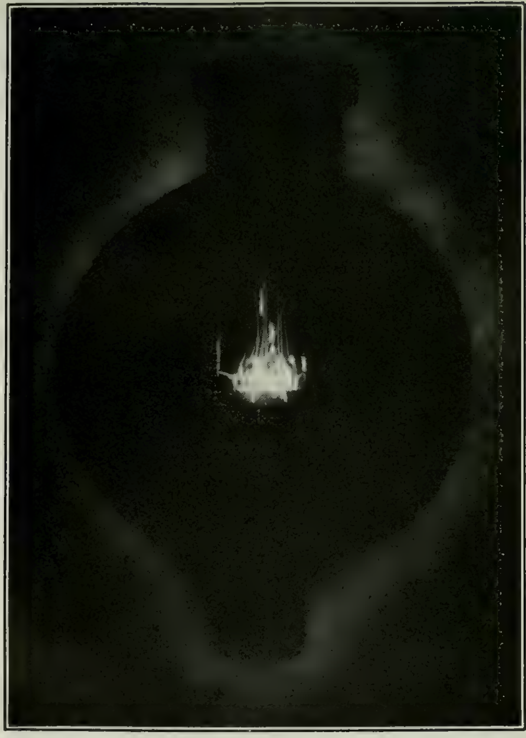
MEASURE OF RELATIVE INFLAMMABILITY.

The inflammability curves in figure 4 indicate that the relative inflammability of the dusts tested by the method used in these experiments may be expressed in terms of any one of several variables; for example, the area below the inflammability curves, the temperature required to develop a certain pressure, or the pressure developed by a certain temperature. All three methods of expressing the results were applied to the data obtained in the study of the face samples of Illinois coal, and the order of inflammability was practically the same with each method. The last-named variable, namely, the pressure developed at a certain coil temperature (1200° C.), has been used by the authors as a measure of relative inflammability.

CLASSIFICATION OF COAL-MINE DUSTS.

Coal-mine dusts may be classified with respect to their inflammability into three groups, as follows: (1) Dusts that, when in suspension in air, may be ignited by a flame from a blown-out shot or by the flame of an oil lamp and give rise to an explosion; (2) dusts that are not ignited by the flame from a blown-out shot or by the flame of an oil lamp, but will propagate an explosion that has originated in a more inflammable mixture of dust or of gas or of both; and (3) dusts that will not propagate an explosion.

Laboratory tests of inflammability furnish a measure of the relative inflammability of dusts, and from the results of such tests dusts may be arranged in the order of their inflammability. However, as the conditions in the laboratory differ so widely from the conditions in the mine, the results of laboratory tests alone do not furnish reliable information as to whether a given dust will propagate a mine explosion. The laboratory results must first be carefully compared with the results of tests on a large scale and under conditions such as exist in



A. APPEARANCE OF FLAME WITH DUST THROUGH 60-MESH AND OVER 80-MESH SCREEN; TEMPERATURE OF COIL 1,200° C.

B. APPEARANCE OF FLAME WITH DUST THROUGH 100-MESH AND OVER 120-MESH SCREEN; TEMPERATURE OF COIL 1,200 C.°

A. APPEARANCE OF FLAME WITH DUST THROUGH 170-MESH AND OVER 200-MESH SCREEN; TEMPERATURE OF COIL 1,200° C.

B. APPEARANCE OF FLAME WITH DUST THROUGH 200-MESH SCREEN; TEMPERATURE OF COIL 1,200° C.

a mine. Only after such a comparison has been made is it possible to predict the behavior of dusts in the mine from the results of laboratory tests.

One of the important problems investigated at the experimental mine of the Bureau of Mines was the determination of the limits between the several classes of dusts named above. At the time the investigation of the inflammability of Illinois dusts was undertaken, the investigations at the experimental mine were in the preliminary stage and no progress had been made on this problem. The laboratory method used in the experiments described in this report was intended especially to furnish information concerning the relative inflammability of dusts.

Since the completion of the experimental part of the present investigation the limits between the three important classes of dusts have been established at the experimental mine. It has been shown that dusts that develop a pressure of 0.5 pound or more in the laboratory apparatus used in this investigation may be ignited by the flame from a blown-out shot, and that certain dusts that develop no measurable pressure in the laboratory test will propagate an explosion. The laboratory method as used in the tests of Illinois dusts is, therefore, not sensitive enough to distinguish between dusts belonging to group 2 and those belonging to group 3.

By recent modifications in the laboratory method measurable pressures are obtained with all dusts that are capable of propagating explosions in the mine.

INFLAMMABILITY OF THE FACE SAMPLES.

TABULATED DATA.

Analyses and inflammability tests were made of 95 face samples from 94 mines. The results are presented in Table 1. The samples are arranged in descending order of inflammability as measured by the pressure developed at a coil temperature of 1200° C. At that temperature the range of pressure is 4.9 to 10.1 pounds per square inch. Dust developing a 0.5-pound pressure or more in the laboratory apparatus, when thrown into suspension in a mine, may be ignited by the flame from a blown-out shot and give rise to an explosion. Coal from any one of the 94 Illinois mines studied, if ground to the proper degree of fineness, will yield a highly inflammable dust, and one that, under suitable conditions, may be expected to give rise to a violent explosion.

TABLE 1.—*Results of analyses and of inflammability tests of face samples.*

Mine No.	Air-drying loss.	Proximate analysis.					Calorific value.	Ultimate analysis.				Pressure at a coil temperature of—				
		Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.		Hydrogen.	Oxygen.	Total carbon.	Nitrogen.	800° C.	900° C.	1,000° C.	1,100° C.	1,200° C.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*B. t. u.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds per square inch.*	*Pounds per square inch.*	*Pounds per square inch.*	*Pounds per square inch.*	*Pounds per square inch.*
95	10.77	5.08	43.13	42.18	9.61	3.68	12,232	5.26	13.09	67.07	1.29	0.3	1.9	4.2	9.3	10.1
94	10.92	3.12	43.01	43.57	10.31	3.56	12,517	5.18	10.67	68.95	1.36	.9	2.3	4.4	8.6	9.8
97	11.20	2.85	41.45	43.51	12.19	2.78	12,155					.3	1.6	3.0	8.2	9.1
9	12.61	4.94	42.06	42.62	10.38	3.66	11,835	5.14	13.53	66.20	1.09	.9	1.7	5.1	8.1	8.9
10	12.32	4.28	42.12	45.77	7.83	3.32	12,465	5.26	13.09	69.36	1.14	.7	1.7	5.1	8.4	8.9
99	8.78	4.03	39.85	47.28	8.84	3.96	12,476	5.16	12.07	68.85	1.12	.3	2.4	7.2	8.2	8.9
3	10.18	5.12	41.88	43.32	9.68	3.73	12,092	5.26	13.18	67.03	1.12	0	.3	3.3	8.0	8.7
8	11.21	5.78	40.52	44.60	9.10	2.60	12,112					.2	1.9	3.5	8.0	8.7
27	10.17	4.96	39.72	44.55	10.77	3.13	11,887	5.39	13.01	66.50	1.20	0	1.5	2.3	8.2	8.7
78	7.83	4.40	41.16	41.99	12.45	3.93	11,666	4.96	a 14.36	64.30		0	1.2	1.9	8.0	8.7
28	11.79	5.95	39.83	43.35	10.87	2.76	11,630	5.30	14.61	65.25	1.21	0	.4	2.6	7.9	8.7
79	7.37	4.47	42.34	42.53	10.66	4.22	11,923	5.14	13.25	65.65	1.03	0	1.2	2.6	7.7	8.6
1	11.24	5.20	40.15	45.19	9.46	3.70	12,078	5.12	13.76	66.80	1.16	0	.9	2.4	7.7	8.4
2	7.36	6.78	40.97	42.78	9.47	3.98	11,808	5.26	15.07	65.14	1.08	0	.5	2.3	7.7	8.4
17	13.38	4.01	42.04	42.80	11.15	5.88	11,889	5.12	11.48	65.34	1.03	.9	2.1	6.8	7.9	8.4
18	9.86	3.98	40.69	44.36	10.97	5.28	12,013	5.14	11.81	65.77	1.03	.3	2.1	3.5	7.9	8.4
100	9.43	3.59	38.96	42.69	14.76	4.05	11,612	4.78	10.61	64.60	1.20	.5	2.3	6.1	7.7	8.4
68	7.54	5.98	41.59	42.69	9.74	4.72	11,646	5.20	14.84	64.45	1.05	0	1.0	2.4	7.0	8.4
6	12.86	6.87	39.98	47.15	6.00	2.30	12,290	5.37	16.07	68.95	1.31	0	1.4	2.8	7.5	8.2
26	10.82	4.94	39.64	42.53	12.89	3.35	11,563	5.01	13.40	64.19	1.16	.2	.5	2.8	7.5	8.2
33	10.50	5.12	38.96	42.42	13.50	3.48	11,543	4.90	12.62	64.30	1.20	.3	.9	1.9	7.5	8.2
91	10.77	3.35	38.34	47.28	11.04	2.74	12,328	4.95	11.24	68.63	1.42	.5	1.2	2.1	7.3	8.2
93	13.27	5.39	38.67	46.61	9.33	2.41	12,221	5.16	13.78	67.90	1.53	.5	1.7	4.4	8.0	8.2
100	7.05	3.55	42.30	43.30	10.85	3.32	12,361					.5	2.4	4.2	7.5	8.2
4	11.22	5.67	39.21	47.93	7.19	2.73	12,539	5.38	13.65	69.78	1.27	0	1.0	2.6	7.2	8.1
52	4.55	2.97	39.13	46.69	11.21	3.26	12,245					.3	1.7	3.2	7.2	8.1
5	9.92	6.77	40.63	45.59	7.01	2.92	12,240	5.41	15.43	68.00	1.23	0	1.2	2.8	7.2	8.0
7	9.57	7.24	40.09	47.02	5.65	2.28	12,433	5.49	15.80	69.49	1.29	0	1.6	2.6	7.2	8.0
19	10.20	4.15	42.30	42.22	11.33	4.52	11,957					.5	1.9	3.1	7.0	8.0
66	6.86	7.90	40.20	41.03	10.87	4.72	11,209	5.25	15.89	62.20	1.07	.2	1.0	2.3	6.6	8.0
80	5.26	5.24	38.61	43.74	12.41	3.99	11,533	4.97	12.73	64.72	1.18	.2	.7	1.7	7.2	8.0
92	13.74	4.42	36.72	46.51	12.36	2.46	11,939	4.77	11.57	67.41	1.44	.7	1.2	1.9	7.3	8.0
Extra	6.91	2.75	38.68	46.03	12.54	4.10	12,317					.5	1.7	4.5	7.0	7.9
11	9.10	4.52	39.68	46.13	9.67	3.35	12,373	5.20	12.16	68.41	1.21	.2	1.6	3.8	7.3	7.9
34	13.80	4.83	38.92	46.15	10.10	3.64	11,885	5.07	13.90	66.04	1.25	.3	.9	1.7	7.2	7.9
64	4.16	5.31	37.26	48.70	8.73	2.28	12,299	5.05	13.72	68.80	1.42	.2	.9	3.7	6.8	7.9

70	6.59	6.44	39.34	42.07	12.15	4.64	11,374	5.00	14.77	62.37	1.07	.2	.9	2.0	7.2	7.9
81	4.80	6.64	41.40	41.33	10.63	4.14	11,637	5.22	15.22	63.96	.83	0	.3	1.7	7.0	7.9
38	7.45	7.58	39.05	42.33	11.04	4.10	11,315	5.08	15.50	63.03	1.25	0	.5	1.7	7.3	7.8
36	11.83	4.81	39.19	44.44	11.56	3.94	11,590	4.95	14.17	64.10	1.28	.2	.7	1.6	6.8	7.7
43	4.54	3.57	36.48	51.30	8.65	2.20	12,778					.3	.7	1.9	7.0	7.7
75	9.00	5.94	40.66	43.24	10.16	3.89	11,691	5.38	14.09	65.34	1.14	0	.5	1.4	6.5	7.7
29	11.50	5.66	38.74	43.62	11.98	3.09	11,500	5.20	13.98	64.57	1.18	0	.5	1.9	6.6	7.5
30	12.70	4.45	39.09	43.57	12.89	3.11	11,633	5.18	12.61	65.05	1.16	0	.5	1.6	6.3	7.5
32	10.79	4.55	40.04	42.21	13.20	3.55	11,749	5.07	11.47	65.55	1.16	0	.4	1.6	6.5	7.5
37	6.27	8.08	38.35	42.14	11.43	4.11	11,090	5.14	15.72	62.37	1.23	0	.3	1.3	6.8	7.5
25	10.75	4.76	40.03	42.78	12.43	3.74	11,723	5.01	11.65	65.95	1.22	.7	1.7	2.4	6.3	7.5
40	10.65	5.44	39.11	44.13	11.32	4.03	11,623	5.10	13.55	64.74	1.26	.1	.9	1.8	6.6	7.4
31	11.86	5.85	39.65	42.64	11.86	3.41	11,574					0	.3	1.7	6.5	7.3
44	4.01	3.28	36.43	51.48	8.81	2.69	12,691	5.19	10.72	70.97	1.62	.3	.9	1.7	6.8	7.3
67	8.12	7.16	39.81	42.11	10.92	4.11	11,381	5.27	15.40	63.16	1.14	.2	.7	2.1	5.9	7.3
82	7.27	5.28	41.12	42.00	11.60	4.55	11,700	5.12	14.00	63.64	1.09	.1	.7	1.2	6.6	7.3
86	5.65	5.80	38.46	43.75	11.99	3.97	11,552	5.01	13.81	64.02	1.20	0	.7	1.4	6.3	7.2
39	6.98	7.11	38.07	41.53	13.29	4.70	11,029	4.95	14.94	60.91	1.21	0	.5	1.9	6.5	7.2
45	4.31	3.41	36.17	52.12	8.30	2.51	12,706	5.24	11.84	70.50	1.61	.2	.7	1.6	6.6	7.2
48	5.05	3.81	35.50	51.64	9.05	2.41	12,575	5.11	11.09	70.79	1.55	0	.5	1.4	6.5	7.2
84	5.85	7.77	38.48	43.08	10.67	4.35	11,324	5.18	15.59	63.14	1.07	0	.5	1.4	6.3	7.2
88	4.42	5.83	37.42	44.06	12.69	3.76	11,317	4.92	13.95	63.55	1.13	0	.7	1.7	6.5	7.2
49	2.90	2.77	38.50	47.33	11.40	4.60	12,343	5.05	9.96	67.54	1.45	0	.3	1.2	6.6	7.2
21	6.87	5.43	40.02	46.31	8.24	2.72	12,388	5.36	13.33	68.95	1.40	.3	1.4	2.8	5.9	7.0
22		4.03	36.90	49.82	9.25	2.42	12,452	5.18	12.54	69.24	1.37	.3	1.4	2.6	6.3	7.0
83	6.35	5.81	38.94	43.13	12.12	4.33	11,399	4.95	14.20	63.49	.91	0	.3	1.4	6.1	7.0
71	4.48	8.01	40.23	40.80	10.96	4.07	11,322	5.22	16.36	62.37	1.02	0	.5	1.6	5.8	6.9
76	8.55	6.22	39.94	42.15	11.69	3.99	11,534	5.04	14.17	63.96	1.15	0	.3	1.4	5.9	6.8
87	4.33	6.66	35.67	46.09	11.58	3.99	11,466	4.99	14.56	63.67	1.21	0	.3	1.4	5.9	6.8
90	5.44	6.40	36.50	46.22	10.88	3.55	11,479					0	.2	1.6	5.4	6.8
73	7.22	7.93	40.74	42.25	9.08	3.93	11,527	5.36	16.48	64.00	1.15	0	.5	1.6	5.9	6.8
58	6.12	4.02	37.16	50.47	8.35	.92	12,483					0	.2	.5	5.9	6.7
15	4.37	4.35	35.20	54.96	5.49	1.52	13,115					0	.7	1.9	5.9	6.6
47	3.40	2.65	36.15	48.38	12.82	3.40	12,263	4.84	9.73	67.87	1.34	0	.7	1.0	5.9	6.6
69	8.10	6.71	39.33	41.59	12.37	4.52	11,232	5.33	14.33	62.32	1.13	0	.5	1.7	5.2	6.6
55	6.38	3.48	36.37	49.25	10.90	2.83	12,154					0	.2	.9	5.6	6.5
46	4.34	4.35	35.40	50.91	9.34	2.84	12,411	5.14	11.26	69.89	1.53	0	.5	1.2	5.8	6.3
50	3.72	6.41	34.47	51.18	7.94	1.04	12,253	5.34	14.90	69.14	1.64	.2	.7	1.9	4.9	6.3
89	4.99	7.91	35.33	47.53	9.23	2.04	11,723	5.12	16.06	66.16	1.39	0	.5	1.4	5.4	6.3
42	7.14	7.69	37.99	44.73	9.59	3.69	11,497	5.19	16.80	63.51	1.22	0	.5	1.6	5.2	6.1
16	3.27	5.77	34.51	53.68	6.04	1.36	12,856	5.25	13.07	72.74	1.54	0	.5	1.4	5.2	5.9
41	9.39	6.63	37.20	43.54	12.63	3.42	11,214	4.96	14.71	63.06	1.22	.2	1.0	1.7	5.2	5.9
72	4.75	8.95	40.18	40.37	10.50	4.26	11,164	5.26	17.09	61.72	1.17	0	.5	1.2	4.7	5.9
85	4.67	8.43	37.53	43.73	10.31	3.59	11,313	5.29	a 16.60	63.02	1.19	0	.3	1.4	4.9	5.9
56	3.11	5.31	35.37	48.55	10.77	2.53	11,974	5.17	a 12.56	67.57	1.40	0	.2	1.3	5.1	5.9
14	3.88	5.07	34.33	53.34	7.26	1.58	12,717	5.10	12.62	71.89	1.55	0	.7	1.2	4.9	5.8
51	6.51	4.44	35.24	52.62	7.70	1.27	12,555	5.20	13.75	70.48	1.60	0	.2	.3	5.1	5.8
74	6.57	8.44	39.61	41.12	10.83	4.80	11,122	5.29	16.48	61.46	1.14	0	.3	1.0	4.5	5.8
63	5.07	5.39	32.91	52.25	9.45	1.67	12,222	4.95	13.04	69.37	1.52	0	.4	1.0	4.2	5.7

a Includes nitrogen content.

TABLE 1.—*Results of analyses and of inflammability tests of face samples*—Continued.

Mine No.	Air-drying loss.	Proximate analysis.					Calorific value.	Ultimate analysis.				Pressure at a coil temperature of—				
		Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.		Hydrogen.	Oxygen.	Total carbon.	Nitrogen.	800° C.	900° C.	1,000° C.	1,100° C.	1,200° C.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*B. t. u.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds per square inch.*	*Pounds per square inch.*	*Pounds per square inch.*	*Pounds per square inch.*	*Pounds per square inch.*
61	3.11	6.82	34.88	50.95	7.35	1.21	12,259	5.14	15.57	69.21	1.52	.1	.5	1.6	4.0	5.6
12	6.60	3.72	33.53	55.67	7.08	1.21	12,906	....	....	....	1.63	.2	.3	.9	4.4	5.4
13	6.42	4.32	33.68	56.11	5.89	1.07	13,075	5.13	12.00	71.42	1.49	0	.3	1.0	4.2	5.4
54	7.51	4.28	37.77	47.11	10.84	.95	11,934	....	....	....	....	0	.2	.5	4.3	5.4
60	5.18	3.87	35.37	51.24	9.52	2.22	12,346	4.92	11.75	70.13	1.46	0	.2	.7	4.1	5.4
65	6.29	4.18	35.09	52.00	8.73	1.79	12,478	5.05	12.17	70.78	1.48	0	.3	.9	4.3	5.4
53	6.68	4.27	35.24	51.48	9.01	.72	12,280	....	....	....	....	.3	.5	.9	4.2	5.1
57	3.45	7.05	32.38	51.51	9.06	.67	12,049	4.99	15.15	68.52	1.61	0	.3	1.0	4.2	5.1
59	3.91	7.24	33.03	50.22	9.51	1.47	11,902	5.08	14.83	67.59	1.52	0	.3	1.4	3.1	4.9
62	3.01	6.79	33.86	51.27	8.08	1.12	12,159	5.12	15.24	68.84	1.60	0	.2	1.6	4.0	4.9

INFLAMMABILITY CURVES.

Inflammability curves for a number of the face samples are contained in figures 6, 7, and 8, in which the abscissa is the temperature of the platinum coil and the ordinate is the pressure developed in the flask. The curves in figure 6 represent the most inflammable dust from each district and those in figure 7 the least inflammable. Curves for all face samples from district 7 are shown in figure 8.

INFLAMMABILITY OF RIB DUSTS.

The study of the face samples has shown that all Illinois coals, when ground to a sufficient degree of fineness, yield dusts that are highly

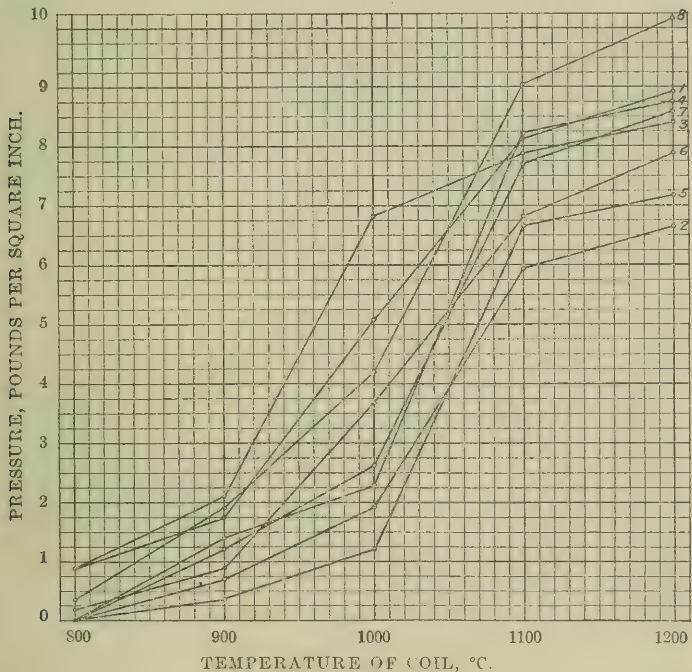


FIGURE 6.—Inflammability curves for the most inflammable face sample from each district. Numbers on curves refer to districts shown on figure 1.

inflammable. The purpose of studying the rib and the road dusts is to ascertain to what extent inflammable dusts are formed and are present in the mines.

TABULATED DATA.

Table 2 contains the results obtained in the study of rib dusts. The samples are arranged in the order of the inflammability of the portion ground to pass a 200-mesh screen, as measured by the pressure developed at a coil temperature of 1,200° C. The table follows:

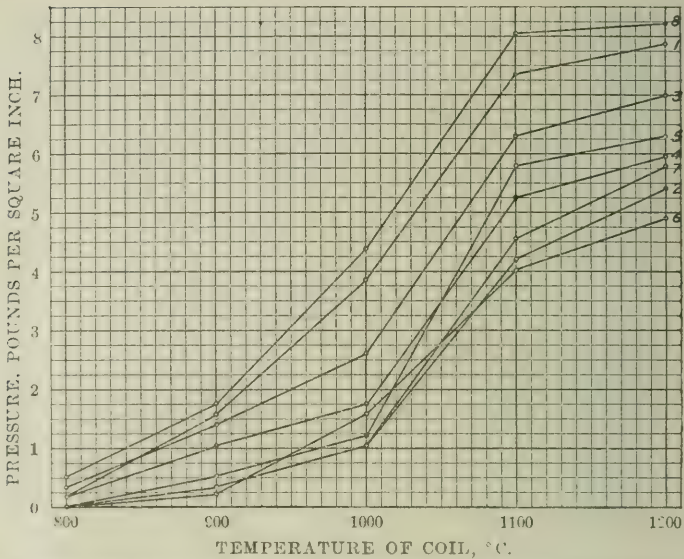


FIGURE 7.—Inflammability curves for the least inflammable face sample from each district. Numbers on curves refer to districts shown on figure 1.

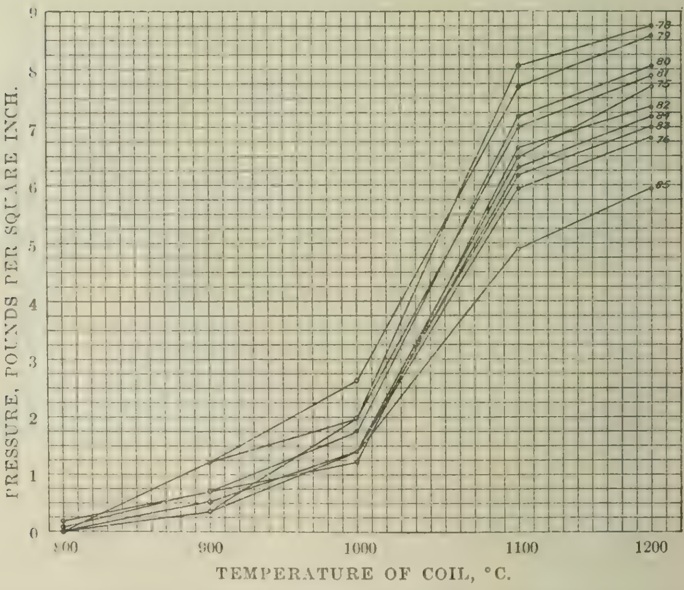


FIGURE 8. Inflammability curves for all face samples of district 7. Numbers on curves refer to mine numbers shown in Table 1.

TABLE 2.—*Results of tests of rib dusts.*

Mine No.	Place of sampling.[a]	Seam.	Air-drying loss.	Dust per square foot.	Results of sizing tests.				Proximate analysis.					Calorific value.	Pressure per square inch of—						
					Dust through a 20-mesh sieve.	Dust through a 60-mesh sieve.	Dust through a 100-mesh sieve.	Dust through a 200-mesh sieve.	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.		Dust through a 20-mesh sieve at a coil temperature of 1,200° C.	Dust through a 200-mesh sieve at a coil temperature of 1,200° C.	Ground dust through a 200-mesh sieve at a coil temperature of—				
																	800° C.	900° C.	1,000° C.	1,100° C.	1,200° C.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
			P. ct.	*Ounces.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
72	1	6	15.79	0.016	29.37	13.26	8.87	6.27	3.70	36.50	44.45	15.35	6.84	11,007	0.0	5.6	0.0	0.3	1.9	8.6	9.3
26	1	5	2.96	.182	86.17	56.59	41.11	24.73	3.20	37.70	38.32	20.78	3.89	10,651	.7	6.5	.0	1.0	2.4	8.4	9.1
9	1	2	20.00	.330	38.53	17.24	10.92	7.73	2.38	41.00	38.82	17.80	3.69	11,014	.0	7.0	.0	1.0	2.6	8.4	9.1
1	1	2	7.55	.314	31.92	15.08	9.37	5.47	2.10	39.80	36.70	21.40	4.22	10,406	.0	5.2	.5	1.2	2.0	7.7	8.9
3	1	2	17.83	.195	39.67	18.86	12.88	7.96	2.10	40.60	34.90	22.40	5.30	10,771	.2	7.9	.0	.3	.9	7.9	8.8
28	1	5	23.23	.170	62.94	33.54	21.96	12.50	3.00	39.20	40.55	17.25	4.27	10,823	.5	7.3	.2	.9	2.1	8.2	8.7
31	1	5	19.21	.655	42.04	16.68	9.28	5.53	2.78	40.17	39.45	17.60	2.54	10,624	.2	6.5	.5	1.9	3.8	7.9	8.7
66	1	6	17.39	.221	57.38	28.77	19.27	11.47	4.45	38.85	45.27	11.43	4.45	11,542	.7	7.7	.7	1.6	2.3	8.4	8.7
71	1	6	7.91	.572	16.19	6.78	4.35	2.88	3.13	41.22	39.25	16.40	3.69	11,221	.3	4.5	.3	1.0	2.4	2.0	8.7
29	1	5	21.83	.352	52.20	26.58	18.42	11.43	2.43	39.07	39.17	19.33	4.17	10,939	1.7	7.2	.2	.9	2.3	8.0	8.6
32	1	5	2.12	.179	59.63	27.93	18.92	11.69	2.10	38.08	40.12	19.70	5.65	11,147	.9	8.9	.6	1.4	2.1	2.1	8.6
36	2	5	22.45	.318	50.51	26.27	17.50	10.83	4.33	37.35	41.39	16.93	4.57	11,005	.5	6.5	.3	.9	2.2	7.7	8.6
72	2	6	15.81	.027	40.71	16.24	9.91	5.86	5.23	36.82	41.15	16.80	4.73	10,262	.3	3.5	.0	.3	.9	7.7	8.4
77	1	6	7.13	.946	67.98	42.79	30.83	20.15	6.15	37.90	43.63	12.32	4.57	11,045	.3	6.6	.2	1.2	2.0	6.6	8.4
25	1	5	21.64	.750	61.04	31.51	21.59	13.15	3.35	37.10	43.90	15.65	4.33	11,428	.2	7.2	.3	.9	2.6	7.9	8.4
4	1	2	15.08	....	17.90	5.88	3.26	1.80	....	....	....	....	....	....	.0	4.2	.0	.3	1.9	7.7	8.2
25	2	5	21.29	.088	69.07	40.07	26.67	16.00	4.23	33.50	40.69	21.58	5.26	10,121	.3	6.8	.0	.5	2.3	7.5	8.2
44	2	5	16.35	.398	72.81	39.31	27.29	16.14	3.60	32.30	52.32	11.78	4.40	11,923	.7	6.1	.2	.9	2.4	7.5	8.2
38	1	5	19.49	.226	56.09	31.82	22.24	13.50	4.78	38.50	39.08	17.64	5.42	10,706	.7	6.3	.5	.9	1.6	7.2	8.0
74	1	6	20.89	.147	38.15	18.71	12.62	8.23	3.65	38.90	40.97	16.48	4.87	10,870	.2	7.5	.0	.5	2.6	7.3	8.0
19	1	1	19.77	....	60.86	35.39	22.44	12.17	2.80	36.90	39.35	20.95	7.33	10,667	.5	6.8	.5	1.7	3.0	7.3	8.0
27	1	5	19.65	.375	49.20	20.81	11.98	7.07	2.75	38.57	36.95	21.73	3.71	10,530	.0	5.9	.2	.7	1.9	7.5	7.9
70	1	6	15.36	.160	32.89	12.85	7.74	4.59	3.00	40.75	34.20	22.05	5.30	10,204	.3	5.8	.2	.7	1.6	7.0	7.9
81	1	6	25.49	.227	66.80	55.30	42.30	26.39	3.23	35.62	42.42	18.73	4.20	10,766	.7	5.4	.0	.7	1.6	7.2	7.9
68	1	6	18.80	.120	55.28	21.69	12.22	7.68	3.48	34.97	45.90	15.65	4.33	11,097	.2	1.6	.2	.3	1.6	7.3	7.9
31	2	5	8.72	.066	72.73	51.54	40.36	27.07	3.78	37.52	35.17	23.53	5.23	9,547	.5	5.8	.0	.3	1.7	7.5	7.9
34	1	5	24.49	.245	53.99	25.18	15.76	9.46	3.75	37.18	42.77	16.30	5.05	11,110	.2	5.8	.2	1.1	1.7	7.7	7.9

[a] Figure 1 indicates that sample was taken from a room; figure 2, that sample was taken from the secondary haulageway; and figure 3, that sample was taken from the main haulageway.

TABLE 2.—*Results of tests of rib dusts*—Continued.

Mine No.	Place of sampling.	Seam.	Air-drying loss.	Dust per square foot.	Results of sizing tests.				Proximate analysis.					Calorific value.	Pressure per square inch of—						
					Dust through a 20-mesh sieve.	Dust through a 60-mesh sieve.	Dust through a 100-mesh sieve.	Dust through a 200-mesh sieve.	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.		Dust through a 20-mesh sieve at a coil temperature of 1,200° C.	Dust through a 200-mesh sieve at a coil temperature of 1,200° C.	Ground dust through a 200-mesh sieve at a coil temperature of— 800° C.	900° C.	1,000° C.	1,100° C.	1,200° C.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
			P. ct.	*Ounces.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
15	2	2	18.79	.106	52.88	28.66	19.76	12.12	3.50	32.35	46.40	17.75	2.71	10,870	.2	4.4	.0	.8	4.4	7.1	7.8
73	2	6	14.00	.183	30.40	18.78	14.49	10.22	4.25	33.75	42.45	19.55	5.00	10,253	.3	4.7	.0	.3	1.9	7.0	7.7
78	1	6	21.91	.220	35.25	15.74	9.94	5.42	3.63	34.57	36.67	25.13	4.80	9,508	.0	4.6	.0	.9	2.1	6.8	7.7
27	2	5	23.01	.180	53.37	15.59	10.03	6.57	4.60	37.15	37.15	21.10	4.87	10,017	.2	5.9	.0	.7	2.1	7.2	7.7
17	1	1	21.15	....	50.06	14.26	7.26	3.13	3.45	37.83	34.02	24.70	7.53	9,887	.2	5.8	.5	1.9	3.3	6.8	7.7
18	1	1	21.36	....	71.96	38.20	22.66	11.33	3.00	36.85	36.61	23.54	8.86	10,184	.2	7.7	.3	2.1	3.5	6.6	7.5
97	2	7	45.39	.111	....	47.91	22.54	10.73	....	....	....	....	....	....	....	....	.0	.3	1.0	3.3	7.5
82	1	6	17.48	.151	40.53	18.04	12.72	7.81	2.73	37.70	34.87	24.70	4.58	9,850	.3	1.2	.0	.7	1.2	7.0	7.5
44	1	5	15.20	.106	51.83	24.45	18.04	11.74	2.50	34.90	42.12	20.48	4.31	10,879	.5	3.7	.2	.7	1.6	5.9	7.5
15	1	2	15.89	.104	41.60	19.32	13.98	8.99	2.43	32.52	48.31	16.74	4.56	11,453	.0	4.3	.0	.2	.9	5.1	7.4
39	1	5	14.79	.299	77.05	49.36	30.40	15.52	7.80	37.50	37.63	17.07	4.56	10,442	.7	6.6	.2	.8	1.2	5.8	7.4
24	1	1	25.36	....	80.18	43.54	30.28	16.63	2.55	37.00	38.10	22.35	6.26	10,710	.3	7.2	.3	1.4	2.6	6.5	7.3
5	1	3	18.85	.165	31.01	13.53	9.95	7.25	....	....	....	....	....	....	.2	1.7	.0	.2	1.7	6.1	7.3
12	1	2	13.04	.390	29.53	15.05	8.56	5.20	2.48	32.82	45.10	19.60	2.79	10,969	.2	4.4	.0	.2	.9	5.8	7.3
36	1	5	22.09	.041	65.26	43.08	31.26	18.92	5.40	35.95	40.40	18.25	4.40	10,570	.7	4.5	.2	.9	2.4	6.6	7.3
78	2	6	18.53	.199	48.56	21.49	15.37	9.61	3.30	33.05	44.72	18.93	4.02	10,672	.0	.7	.0	.5	1.7	6.8	7.3
48	1	5	13.45	.129	61.46	33.30	24.69	16.31	2.63	32.07	53.70	11.60	3.12	12,139	.5	2.1	.0	.3	1.4	6.4	7.2
73	1	6	11.19	.182	15.99	5.34	3.57	2.44	....	....	....	....	....	....	.2	.3	.0	.4	1.1	5.4	7.2
13	1	2	14.30	.137	53.02	32.13	22.70	13.02	2.78	32.80	52.52	11.90	2.54	12,325	.2	5.6	.0	.7	1.4	6.5	7.1
13	2	2	14.79	.043	53.18	20.90	14.46	8.16	4.05	32.15	50.47	13.33	3.01	11,399	.2	2.3	.0	.3	1.0	4.4	7.1
47	1	5	14.73	.085	61.70	33.29	22.36	13.56	1.80	34.18	44.47	19.25	4.81	11,196	.0	5.9	.0	.4	.9	6.5	7.0
88	3	6	....	....	....	....	....	....	4.33	33.12	38.27	24.28	3.72	9,666	.3	4.2	.0	.3	1.3	4.7	7.0
37	1	5	20.98	.292	79.67	50.08	35.97	18.56	4.88	35.40	40.39	19.33	5.72	10,546	.3	5.4	.0	.2	.5	5.6	7.0
69	1	6	23.48	.193	76.29	43.09	31.14	17.67	3.55	34.48	42.02	19.95	4.27	10,568	.3	4.2	.0	.5	1.6	6.1	6.8
75	1	6	17.43	.758	65.73	39.30	26.46	16.39	4.85	35.63	41.69	17.83	4.81	10,508	.3	5.1	.2	.3	1.9	5.4	6.8
83	2	6	13.23	.070	26.73	11.41	7.56	4.35	3.05	37.40	36.27	23.28	4.40	9,806	.0	4.2	.0	.3	1.4	6.3	6.8
79	1	6	16.40	.085	40.81	22.70	16.65	10.23	2.95	34.62	40.98	21.45	3.62	10,282	.0	.7	.0	.2	1.6	6.3	6.8
91	1	6	14.28	....	42.33	23.13	14.20	8.23	4.33	33.97	48.22	13.48	1.27	11,543	.5	1.7	.2	.2	1.7	4.9	6.8
67	1	6	19.90	.094	49.14	16.97	10.52	6.60	3.95	33.80	41.92	20.33	4.23	10,375	.0	1.2	.0	.5	2.3	6.1	6.7
8	1	2	18.69	....	46.07	19.18	10.67	5.97	2.65	34.23	34.99	28.13	3.51	9,611	.0	4.9	.0	.3	1.0	5.8	6.7

48......	2	5	17.37	.098	44.78	12.96	8.87	5.99	3.55	29.40	45.27	21.78	2.14	9,734	.2	.3	.0	.2	.5	1.2	6.6
52......	2	6	3.69	.041	59.27	37.21	30.29	23.29	3.19	38.61	39.70	18.50	3.17	11,018	....	....	.0	.5	.9	4.5	6.6
76......	1	6	12.99	.386	39.43	19.65	12.70	7.31	4.10	35.78	40.69	19.43	4.04	10,514	.2	4.5	.0	.3	.7	5.8	6.6
76......	2	6	17.38	.168	59.13	25.66	18.36	11.22	5.73	32.95	43.19	18.13	4.29	10,328	.0	1.2	.0	.5	1.7	5.7	6.6
79......	2	6	16.60	.139	36.69	17.40	11.70	7.10	3.58	36.57	37.63	22.22	4.24	9,983	.5	5.1	.0	.2	1.4	5.2	6.6
95......	1	6	15.41	....	....	63.34	53.20	37.32	....	....	....	....	....	....	....	....	....	.3	.9	3.5	6.6
26......	2	5	12.08	.472	87.14	71.83	59.61	40.98	5.80	37.13	29.94	27.13	6.43	8,962	1.4	5.8	.0	.3	2.1	5.6	6.6
29......	3	5	9.87	.348	71.06	49.37	33.44	19.12	6.20	37.63	29.66	26.51	6.01	8,924	.3	6.6	.0	.2	.9	2.6	6.6
40......	1	5	22.49	.320	64.70	24.11	16.43	6.52	6.00	36.80	39.45	17.75	3.81	10,535	.5	4.2	.0	.5	1.3	4.4	6.6
90......	2	6	12.03	.279	39.61	25.29	14.51	7.66	4.55	37.15	41.35	16.95	3.93	10,712	.0	5.8	.2	.3	1.4	5.9	6.6
10......	1	2	13.17	....	10.84	2.09	.87	.74	....	....	....	....	....	....	.0	.3	.0	.5	1.9	6.3	6.6
33......	1	5	21.72	.284	62.98	17.78	9.89	4.19	5.15	36.40	36.77	21.68	3.51	10,237	.0	4.0	.0	.3	.9	5.8	6.5
100.....	1	3	4.62	.080	37.46	20.40	14.35	8.53	....	....	....	....	....	....	.2	1.9	.0	.3	.9	5.1	6.5
88......	2	6	10.41	.115	76.34	60.97	50.00	40.27	3.03	34.67	38.20	24.10	3.83	10,006	.2	4.7	.2	.7	1.0	5.5	6.5
43......	1	5	8.83	.278	55.63	33.22	21.85	12.81	4.28	31.47	46.27	17.98	5.05	10,784	.2	3.8	.0	.2	1.3	4.7	6.3
90......	1	6	13.75	.235	68.75	43.56	30.86	16.52	4.35	34.85	40.52	20.28	5.06	10,071	.5	5.8	.0	.2	.7	5.4	6.3
93......	1	6	13.95	....	58.02	36.37	29.78	17.64	4.63	37.17	46.62	11.58	1.68	11,774	.2	3.2	.0	.3	1.0	5.8	6.3
86......	1	6	19.06	.346	65.31	47.09	36.50	23.84	5.48	34.32	43.65	16.55	5.11	10,640	.3	5.6	0	.3	1.0	5.6	6.2
77......	2	6	4.61	.099	66.23	43.27	31.19	16.73	7.40	38.80	31.37	22.43	5.69	9,110	.3	5.1	0	0	.2	4.2	6.1
26......	3	5	28.43	.215	84.38	69.54	63.56	55.48	4.00	34.65	26.21	35.14	4.03	7,879	3.5	5.8	0	.3	1.0	5.2	6.1
41......	1	5	7.15	.099	31.64	40.13	30.63	19.54	7.28	33.55	40.54	18.63	4.35	10,004	1.0	4.3	0	.4	1.4	5.2	6.1
33......	2	5	6.69	.399	88.41	60.22	41.97	24.67	7.50	36.78	36.44	19.28	5.18	9,895	.9	3.6	0	.3	1.7	5.4	5.9
28......	3	5	8.83	.019	19.31	6.10	3.55	2.20	....	....	....	....	....	....	0	0	0	.3	1.0	4.9	5.9
62......	2	6	24.29	.100	77.73	54.89	48.21	37.59	3.66	33.32	51.21	11.81	2.01	12,103	....	....	0	.5	1.2	4.4	5.9
80......	1	6	6.52	.447	87.90	64.13	49.76	32.64	5.65	35.85	38.78	19.78	4.88	9,988	.5	4.2	0	.3	.9	5.2	5.9
52......	1	6	8.17	.035	42.51	30.48	24.39	18.09	4.54	35.11	45.46	14.89	1.95	11,426	....	....	0	.2	.9	2.8	5.8
54......	2	6	17.72	.065	53.42	28.34	20.82	14.59	5.03	33.16	49.57	12.24	1.06	11,657	....	....	.2	.5	2.3	4.2	5.8
57......	2	6	9.76	....	65.30	44.48	36.21	28.44	4.81	30.59	42.53	22.07	2.74	10,123	....	....	0	.5	.9	3.1	5.8
14......	1	2	17.64	.295	75.53	43.67	33.00	17.10	2.50	33.38	44.61	19.51	1.59	10,721	.3	4.7	0	.2	.5	4.6	5.8
29......	2	5	8.68	.129	52.81	31.40	24.50	19.09	4.50	34.60	26.50	34.40	4.31	7,900	.2	.2	0	.5	1.1	5.1	5.8
95......	2	6	24.43	....	....	78.82	70.38	45.01	....	....	....	....	....	....	....	....	0	.9	1.2	3.0	5.8
34......	2	5	28.91	.508	64.69	39.35	25.88	14.27	6.45	34.63	34.42	24.50	5.30	8,996	.2	1.7	0	0	.7	1.7	5.7
12......	2	2	20.10	....	68.34	34.27	26.72	15.88	2.83	29.77	44.82	22.58	2.19	10,490	0	4.7	0	.2	.7	4.0	5.6
49......	1	5	10.04	.176	67.71	48.42	38.12	26.56	....	....	....	....	....	....	0	2.9	0	.2	.7	4.4	5.6
11......	1	2	13.01	.225	17.15	5.90	3.91	2.63	....	....	....	....	....	....	0	.2	0	0	.2	4.2	5.6
50......	3	6	5.72	.033	38.54	21.73	15.31	9.07	4.33	29.47	41.87	24.33	4.20	9,794	.2	1.2	0	.3	.7	2.1	5.4
63......	1	6	16.67	.087	71.98	51.82	41.87	30.74	3.74	33.30	48.46	14.50	1.75	11,569	....	....	0	.3	2.3	5.4	5.4
38......	2	5	11.11	.967	81.55	60.76	44.36	24.36	7.38	33.05	38.02	21.55	4.83	9,164	.2	3.1	0	.2	.5	3.1	5.4
65......	1	6	19.17	.120	85.09	66.70	51.95	35.99	4.63	32.33	40.20	22.85	3.00	10,022	....	....	0	.3	.5	1.2	5.3
32......	2	5	12.35	.615	81.41	57.55	41.66	27.68	5.98	37.62	27.90	28.50	6.62	8,082	.2	3.7	0	.2	.5	3.0	5.3
45......	3	5	11.20	.592	73.88	44.68	30.91	17.43	4.60	29.90	44.55	20.95	3.71	10,489	.2	3.1	0	.2	.5	4.2	5.2
46......	1	5	14.02	.345	68.03	40.45	24.79	11.12	3.70	30.43	42.30	23.57	5.55	10,138	.9	3.1	0	.5	1.4	4.5	5.1
39......	2	5	11.71	.614	89.25	46.41	44.23	22.91	8.85	32.88	30.94	27.33	5.51	8,221	.2	3.1	0	.2	.7	2.5	5.0
71......	2	6	7.19	....	35.49	18.88	12.45	8.22	5.70	37.40	26.00	30.90	5.48	8,060	.2	.3	0	.2	.5	4.0	4.9
89......	3	6	18.26	.096	52.97	32.27	22.94	14.98	4.25	32.55	42.52	20.68	3.05	10,147	.2	4.2	0	.2	.5	1.6	4.9
37......	2	5	8.50	.704	66.44	42.94	32.11	24.03	6.60	33.80	37.82	21.78	5.06	9,587	.3	.5	0	.2	.3	3.1	4.9
28......	2	5	14.12	.282	56.54	27.37	17.30	8.50	6.58	34.07	25.25	34.10	5.09	7,735	0	1.7	0	.2	.3	2.3	4.8
89......	2	6	16.70	.095	40.04	22.44	16.95	10.26	5.55	32.30	40.85	21.30	3.80	9,568	.3	4.5	0	.2	.7	2.6	4.7
92......	1	6	18.90	....	53.33	26.06	15.10	8.86	6.25	30.87	47.37	15.53	1.43	11,027	.2	.3	0	0	.3	2.8	4.7
62......	3	6	21.49	.376	58.81	26.65	20.60	14.53	4.14	34.13	48.54	13.19	1.19	11,693	....	....	0	.3	.7	3.0	4.5
75......	3	6	12.31	.830	83.81	69.75	56.71	40.73	6.18	32.42	41.12	20.28	5.79	9,335	.5	3.0	0	.2	.7	3.1	4.5
87......	1	6	8.38	.112	43.01	17.57	9.57	4.91	5.43	37.32	32.60	24.65	5.11	9,563	0	2.8	0	0	.2	1.2	4.5

TABLE 2.—*Results of tests of rib dusts*—Continued.

Mine No.	Place of sampling.	Seam.	Air-drying loss.	Dust per square foot.	Results of sizing tests. Dust through a 20-mesh sieve.	Dust through a 60-mesh sieve.	Dust through a 100-mesh sieve.	Dust through a 200-mesh sieve.	Proximate analysis. Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value.	Pressure per square inch of— Dust through a 20-mesh sieve at a coil temperature of 1,200° C.	Dust through a 200-mesh sieve at a coil temperature of 1,200° C.	Ground dust through a 200-mesh sieve at a coil temperature of— 800° C.	900° C.	1,000° C.	1,100° C.	1,200° C.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
			P. ct.	*Ounces.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
59	1	6	19.08	.200	86.43	72.86	62.45	45.53	4.75	31.76	47.20	16.29	2.57	11,097	......	......	0	.3	.5	1.8	4.5
9	2	2	10.63	......	38.36	29.68	25.80	21.94	......	......	......	......	......	......	0	.2	0	0	.2	2.3	4.2
46	3	5	12.81	.431	69.64	46.02	30.64	21.81	4.40	28.97	39.18	27.45	3.88	9,543	.5	1.0	0	.2	1.0	1.7	3.9
56	1	6	12.10	.019	48.97	30.46	23.14	15.29	4.99	32.53	46.69	15.79	1.67	11,176	......	......	0	.3	.7	3.1	3.7
38	3	5	4.81	.246	86.60	81.29	77.32	71.60	4.28	26.55	26.44	42.73	3.15	7,022	3.8	5.1	0	.2	.3	1.8	3.6
34	3	5	8.62	.076	34.18	22.95	17.14	13.76	4.88	32.22	25.35	37.55	5.31	7,333	1.6	2.8	0	0	0	3.0	3.6
50	1	6	6.42	.058	67.02	50.28	42.39	32.82	3.65	27.55	38.95	29.85	1.50	9,061	.7	.3	0	.2	.9	1.6	3.3
60	1	6	19.26	.033	60.22	38.54	30.02	22.18	4.21	31.10	52.37	12.32	2.84	11,718	......	......	0	.3	.7	1.6	3.3
41	2	5	3.91	.045	31.00	14.40	9.03	5.61	......	......	......	......	......	......	0	.7	0	.2	.3	1.7	3.3
92	2	6	20.68	......	82.91	57.30	34.69	10.82	5.65	30.75	47.80	15.80	1.68	11,068	.3	.5	0	.2	.5	2.1	3.3
19	2	1	23.30	......	40.64	9.66	5.83	3.25	5.28	35.50	14.82	44.40	6.80	6,325	0	1.9	0	.3	.7	1.4	3.1
57	3	6	8.99	......	66.97	51.69	44.15	35.10	......	......	......	......	......	......	......	......	0	.2	.3	2.1	3.0
65	2	6	20.16	.258	80.80	48.19	36.55	26.66	6.42	34.16	42.71	16.71	4.14	9,997	......	......	0	.3	.5	1.6	3.0
76	3	5	5.96	.110	17.16	8.94	6.19	4.90	6.55	30.95	31.75	30.75	5.75	7,519	.2	0	0	.2	1.0	2.3	3.0
81	2	6	15.20	.254	59.60	42.30	33.70	21.30	4.35	35.80	33.35	26.50	6.12	8,885	.2	.2	0	.2	.5	2.4	3.0
75	2	6	8.11	1.057	79.72	58.02	41.98	28.69	8.00	33.00	36.40	22.60	6.06	8,075	.2	.2	0	.2	.7	1.4	2.8
14	2	2	18.81	.009	35.00	10.88	7.08	3.96	4.55	31.30	40.20	23.95	3.54	8,710	0	.7	0	0	.2	.3	2.7
64	1	6	29.10	.462	94.59	53.00	42.66	22.40	3.13	30.65	53.27	12.95	2.30	12,004	......	......	0	.2	.5	1.2	2.6
88	1	6	8.01	.057	59.02	35.45	23.59	14.45	5.18	37.09	31.73	26.00	5.07	8,381	.2	1.4	0	0	0	.2	2.2
10	3	2	6.86	......	65.92	49.74	43.10	39.42	2.90	24.85	21.92	50.33	4.04	5,591	0	.2	0	0	.2	.9	2.3
74	3	6	9.74	.172	20.88	7.39	4.53	3.11	4.20	35.00	28.75	32.05	4.36	7,673	0	2.1	0	0	.2	.7	2.1
57	1	6	14.19	......	67.41	49.09	39.89	29.77	4.70	28.69	44.47	22.14	1.61	10,206	......	......	0	.2	.3	1.4	1.9
52	3	6	4.76	.110	57.00	29.32	22.82	17.48	4.27	32.69	34.36	28.68	5.05	8,827	0	0	0	.3	.4	.6	1.9
93	3	6	11.11	......	83.66	66.62	43.25	19.41	6.07	29.23	34.85	29.85	3.04	8,741	.3	.5	0	0	.2	.7	1.9
24	2	1	9.68	......	24.77	11.60	7.28	3.79	5.00	32.13	28.17	34.70	6.24	7,290	.3	1.4	0	.2	.5	1.4	1.9
73	3	6	8.45	.207	43.57	27.57	19.91	12.26	6.50	35.05	29.37	29.08	7.13	7,592	0	.7	0	0	.2	.7	1.7
33	3	5	3.76	.101	45.48	17.95	12.58	7.34	8.00	32.63	29.94	29.34	5.39	8,077	.3	.7	0	.2	.3	.7	1.6
54	3	6	11.18	.067	73.58	55.27	47.94	36.94	5.45	28.25	35.55	30.75	2.51	8,474	......	......	0	.2	.3	1.1	1.5
58	3	6	7.26	.088	58.17	43.36	39.53	33.99	4.90	31.42	42.31	21.37	1.84	10,229	......	......	0	.2	.3	.7	1.3
85	3	6	5.58	.205	50.36	27.40	22.04	17.14	7.10	33.93	29.89	29.08	5.39	8,267	.3	.5	0	0	.2	.6	1.2

63......	2	6	16.96	.222	78.28	44.43	28.85	17.21	6.32	32.40	31.76	29.52	3.83	8,503	....	....	0	.2	.3	.7	1.2
18......	2	1	10.20	....	73.23	53.62	45.85	29.32	3.90	28.15	17.60	50.35	7.04	5,396	.2	.9	0	.2	.3	.9	1.2
85......	2	6	3.76	.249	80.17	62.96	54.71	44.23	8.98	31.75	34.80	24.47	6.43	8,262	.5	1.2	0	0	.2	.3	1.1
54......	1	6	7.93	.022	86.80	73.11	65.78	50.30	5.06	29.54	46.10	19.30	2.00	10,395	....	....	.2	.2	.3	.9	1.1
86......	3	6	8.15	.312	43.10	19.62	12.71	8.39	5.65	31.85	39.12	23.38	5.88	9.176	.2	.3	0	0	0	.2	1.1
55......	2	6	19.04	.120	54.07	33.82	23.65	13.73	3.23	28.73	44.33	23.71	0.96	10,093	....	....	0	0	.2	.2	1.0
69......	2	6	27.19	.121	75.07	46.19	33.91	21.86	5.75	32.33	37.84	24.08	5.84	8,609	1.0	3.2	0	.2	.2	.4	1.0
66......	2	6	10.48	.306	45.20	21.40	15.97	10.48	5.50	31.76	33.16	29.58	5.97	7,315	0	.2	0	0	.2	.7	1.0
72......	3	6	9.60	....	40.43	21.99	15.34	10.05	6.80	35.38	30.92	26.90	6.15	7,619	0	.2	0	0	.2	.3	1.0
80......	2	6	8.66	.236	41.15	17.11	11.02	5.92	7.13	38.97	26.30	27.60	9.12	7,195	0	.2	0	0	.2	.3	1.0
85......	1	6	5.56	.194	91.30	73.79	57.68	40.35	7.85	32.40	38.32	21.43	6.08	9,148	.3	1.4	0	0	.2	.5	1.0
66......	3	6	....	....	....	(a)	....	....	5.50	31.76	33.16	29.58	5.97	7,315	0	.2	0	0	.2	.7	1.0
27......	3	5	11.06	.201	56.19	42.81	36.31	27.63	5.63	30.87	15.05	48.45	5.05	5,531	.2	.3	0	0	0	0	.9
83......	3	6	9.68	.524	75.51	51.55	39.98	24.91	6.00	32.75	27.82	33.43	5.30	7,144	.2	.7	0	0	0	.3	.9
58......	2	6	5.75	.056	54.76	31.44	26.73	21.79	5.11	36.23	40.46	18.20	1.87	10,273	....	....	0	.2	.3	.7	.9
53......	2	6	14.19	.089	67.99	33.35	22.91	16.44	5.30	31.28	50.91	12.51	.43	11,324	....	....	0	.2	.3	.7	.9
53......	3	6	5.16	.510	54.48	41.08	36.48	33.21	4.72	26.42	47.77	21.09	.56	10,433	....	....	0	.2	.3	.5	.9
56......	2	6	7.16	.125	50.62	29.30	20.93	14.55	5.32	35.35	40.20	19.13	1.52	9,970	....	....	2	.2	.3	.5	.9
59......	2	6	17.67	.070	82.84	67.48	60.31	50.52	5.35	29.36	44.79	20.50	3.05	10,229	....	....	0	.2	.3	.5	.9
62......	1	6	6.77	.392	90.55	85.15	82.55	76.72	4.42	26.15	32.05	37.38	2.74	7,864	....	....	0	.2	.3	.5	.9
65......	3	6	24.68	.208	76.79	53.87	46.32	35.38	5.76	29.99	45.59	18.66	3.38	9,533	....	....	0	.1	.2	.3	.9
68......	2	6	7.52	.185	34.85	21.22	15.96	11.62	4.83	31.82	33.02	30.33	6.88	7,664	0	0	0	0	.2	.3	.9
36......	3	5	8.94	.055	78.09	56.36	41.23	24.83	7.55	33.63	30.84	27.98	5.78	7,992	.3	1.6	0	0	.3	.3	.9
45......	1	5	1.50	.255	61.61	40.80	32.21	22.91	3.90	28.40	43.50	24.20	5.08	9,437	.9	.7	0	0	0	.3	.9
56......	3	6	14.19	.062	52.26	32.94	24.93	18.71	5.45	31.10	42.63	20.82	2.06	10,105	....	....	0	.2	.3	.8	.8
60......	2	6	19.93	.094	87.95	73.32	62.91	49.16	5.55	30.91	46.55	16.99	3.09	10,166	....	....	0	0	.2	.7	.8
64......	2	6	22.02	.464	65.88	27.80	21.85	15.08	5.41	32.76	44.96	16.87	3.14	9,817	....	....	0	0	.2	.5	.8
40......	2	5	13.38	.456	87.28	71.49	53.23	35.02	7.75	31.95	39.30	21.00	5.10	8,545	.3	1.2	0	0	.2	.5	.8
51......	3	6	11.78	.222	71.77	61.23	58.92	56.26	4.37	30.17	40.11	25.35	3.05	9,430	....	....	0	.2	.5	.6	.7
53......	1	6	6.27	.296	81.68	68.83	60.10	47.47	6.48	27.57	49.15	16.80	1.38	10,526	....	....	0	.2	.2	.4	.7
55......	1	6	12.32	.200	81.34	50.77	37.62	24.59	4.78	32.24	44.58	18.40	2.81	9,967	....	....	0	.2	.3	.5	.7
55......	3	6	13.13	.121	87.90	64.25	50.59	32.49	4.38	29.79	43.87	21.96	1.70	9.909	....	....	0	0	.2	.3	.7
58......	1	6	9.61	.052	45.46	27.92	23.63	18.26	4.05	30.34	41.15	24.46	.83	9,857	....	....	0	0	.2	.4	.7
63......	3	6	6.53	.265	88.05	71.67	59.55	41.18	6.20	38.11	21.06	34.63	6.55	7,306	....	....	0	.2	.3	.3	.7
77......	3	6	9.79	.300	52.52	37.21	31.24	23.65	6.35	29.10	29.87	34.68	5.22	7,456	.2	0	0	0	0	.2	.7
84......	1	6	....	....	....	....	....	....	7.43	31.62	23.87	37.08	5.66	6,777	.2	.2	0	0	0	0	.7
87......	2	6	4.34	.233	64.89	38.01	25.93	16.65	8.23	35.87	32.65	23.25	6.82	8,354	.2	1.2	0	0	0	.2	.7
50......	2	6	12.22	.005	47.08	22.06	14.90	7.87	5.15	32.10	37.50	25.25	5.67	9,144	0	.7	0	0	.2	.3	.7
93......	2	6	6.89	....	80.33	59.40	44.51	32.33	6.33	29.67	28.07	35.93	2.93	7,571	.2	.2	0	0	0	.3	.7
51......	1	6	16.00	.225	51.62	22.67	17.32	11.85	4.31	28.61	45.11	21.97	2.37	10,300	....	....	0	.3	.5	.6	.6
51......	2	6	13.59	.408	58.94	31.62	25.19	19.00	4.03	38.56	25.15	32.26	3.90	8,075	....	....	0	.1	.2	.4	.6
60......	3	6	8.91	.228	66.38	49.32	43.50	38.21	5.39	33.42	36.93	24.26	3.63	8,469	....	....	0	.2	.3	.4	.5
67......	2	6	6.82	.444	67.47	47.57	39.19	26.38	7.33	34.38	22.71	35.58	6.24	6,754	.5	.5	0	0	0	0	.5
67......	3	6	5.27	.663	62.76	32.35	24.24	15.63	5.10	25.25	20.85	48.80	3.65	5,483	.2	.7	0	0	0	0	.5
7......	1	2	17.14	....	24.59	10.16	7.06	5.32	1.55	23.38	26.54	48.53	2.49	6,661	0	.2	0	0	0	0	.5
37......	3	5	10.57	.710	68.86	45.13	34.65	25.41	6.63	32.17	31.67	29.53	5.59	7,355	.2	.2	0	0	0	0	.5
44......	3	5	8.21	.139	56.15	35.21	26.24	14.70	3.15	27.03	32.54	37.28	5.20	6,968	.2	.2	0	0	0	.3	.5
91......	3	6	12.00	....	76.90	55.63	39.63	21.72	6.28	27.12	29.65	36.95	2.93	7,418	.3	.3	0	0	0	.3	.5
82......	2	6	9.94	.217	52.08	33.27	27.21	14.75	4.75	37.93	18.14	39.18	7.54	5,879	.2	.5	0	0	0	0	.4
49......	2	5	7.48	.100	56.25	32.33	22.40	15.26	6.20	34.15	29.15	30.50	9.53	6,961	0	.5	0	0	0	0	.3
49......	3	5	8.40	.246	69.43	57.59	52.41	43.54	3.98	25.77	26.60	43.65	7.21	5,760	.2	.2	0	0	0	0	.3

[a] No data.

TABLE 2.—*Results of tests of rib dusts*—Continued.

Mine No.	Place of sampling.	Seam.	Air-drying loss.	Dust per square foot.	Results of sizing tests. Dust through a 20-mesh sieve.	Dust through a 60-mesh sieve.	Dust through a 100-mesh sieve.	Dust through a 200-mesh sieve.	Proximate analysis. Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value.	Pressure per square inch of— Dust through a 20-mesh sieve at a coil temperature of 1,200° C.	Dust through a 200-mesh sieve at a coil temperature of 1,200° C.	Ground dust through a 200-mesh sieve at a coil temperature of— 800° C.	900° C.	1,000° C.	1,100° C.	1,200° C.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
			P. ct.	*Ounces.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
69	3	6	9.24	.469	60.92	38.15	31.68	26.62	5.23	24.22	22.22	48.33	5.55	4,511	.2	.2	0	0	0	0	0.3
70	3	6	4.79						10.53	31.57	22.37	35.53	6.75	5,179	0	.2	0	0	0	0	.3
74	2	6	8.32	.425	18.56	6.64	4.18	2.55	5.50	36.30	18.20	40.00	5.35	6,309	0	.2	0	0	0	0	.3
78	3	6	9.21	.283	39.13	17.02	10.33	5.20	5.13	37.07	26.65	31.15	6.83	6,714	0	0	0	0	0	0	.3
81	3	6	5.05	.168	39.95	27.44	22.00	18.09	5.23	30.27	30.25	34.25	6.24	7,160	.2	.2	0	0	0	0	.3
82	3	6	11.63	.466	59.94	35.88	24.95	12.73	6.25	39.28	14.92	39.55	9.02	4.990	0	0	0	0	0	0	.3
83	1	6	9.30	.293	63.85	38.18	28.15	17.67	6.68	34.27	16.75	42.30	6.71	5,182	0	.2	0	0	0	0	.3
15	3	2	12.55		51.84	26.94	19.24	10.39	4.60	34.13	31.99	29.28	5.75	7,114	.3	.5	0	0	0	0	.3
32	3	5	9.03	.785	73.78	44.86	30.42	18.15	9.23	39.17	18.52	33.08	8.14	6,046	0	3.7	0	0	0	0	.3
40	3	5	7.49	.137	69.20	53.59	47.64	42.38	5.78	27.55	21.39	45.28	5.51	5,540	.2	.2	0	0	0	0	.3
42	3	5	8.31	.097	57.99	46.18	43.09	13.38		29.35			6.70	5,497	0	.2	0	0	0	0	.3
43	2	5	19.69	.193	63.49	22.74	13.23	8.14	7.25	37.13	17.82	37.80	9.74	5,661	.2	.7	0	0	0	0	.3
45	2	5	8.81	.217	61.89	29.82	18.20	10.82	5.28	35.09	29.45	30.18	9.20	7,000	0	.2	0	0	0	0	.3
46	2	5	2.39	.268	43.09	29.39	21.25	13.29	4.18	28.37	32.17	35.28	6.61	7,524	.5	.5	0	0	0	0	.3
100	3	3	4.10		16.13	8.09	4.22	2.98							.2	.5	0	0	0	0	.3
79	3	6	12.10	.554	48.30	26.10	19.00	12.20	5.90	33.20	25.47	35.43	6.60	6,181	0	.9	0	9	0	0	.3
91	2	6	9.37		74.44	55.62	41.82	28.58	5.65	26.05	20.30	48.00	2.96	6,008	.3	.3	0	0	0	0	.3
92	3	6	6.06		62.38	46.12	34.41	24.00	5.58	25.92	19.95	48.55	2.94	5,555	.2	.2	0	0	0	0	.2
47	2	5	9.07	.109	50.91	16.06	10.20	5.78	4.30	43.22	22.68	29.80	7.89	5,931	0	0	0	0	0	0	.2
59	3	6	7.15	.264	86.13	70.91	64.93	59.60	4.32	26.31	28.04	41.33	2.41	6,851			0	0	0	0	.2
89	1	6	16.58	.236	51.86	32.05	20.41	9.71	6.50	37.55	11.27	44.68	6.79	4.333	0	0	0	0	0	0	.2
11	3	2	4.23		66.68	64.93	64.48	64.16	2.25	21.32	19.50	56.93	2.69	4,666	0	0	0	0	0	0	.2
13	3	2	12.67	.140	64.45	43.35	31.48	21.61	5.23	31.37	18.27	45.13	6.28	4.444	.2	0	0	0	0	0	.2
39	3	5	3.95	.633	44.84	32.05	23.75	18.38	8.15	31.80	15.95	44.10	6.97	4,711	1.0	.2	0	0	0	0	.2
41	3	5	6.21	.169	36.43	21.48	16.27	12.30	7.10	30.78	8.99	53.13	8.72	3,724	0	0	0	0	0	0	.2
42	1	5	4.66	.024	26.15	13.45	8.51	6.11							0	0	0	0	0	0	.2
43	3	5	3.61	.675	47.07	31.37	17.25	12.48	5.85	30.50	26.12	37.53	5.45	5,738	0	.3	0	0	0	0	.2
97	3	7	48.02			18.81	8.59	4.39									0	0	0	0	0
1	2	2	3.49	.337	27.00	18.56	15.91	12.67	2.63	17.30	6.47	73.60	3.85	2,455	0	0	0	0	0	0	0
11	2	2	2.09		22.82	15.47	13.83	13.03	1.30	11.85	6.35	80.50	1.01	1,757	0	0	0	0	0	0	0

1......	3	2	2.95	.330	18.54	10.70	9.19	8.31	2.75	16.30	2.55	78.40	4.13	1,022	0	0	0	0	0	0	0
10......	2	2	3.12	....	28.18	14.19	9.44	6.50	1.85	10.90	3.30	83.95	3.06	1,208	0	0	0	0	0	0	0
2......	1	2	7.51	....	36.79	18.22	17.42	14.73	7.80	28.15	4.47	59.58	10.42	1,438	0	0	0	0	0	0	0
42......	2	5	3.56	.038	8.40	3.26	2.20	1.51	....	....	....	....	....	....	0	.2	0	0	0	0	0
4......	2	2	2.78	....	53.18	45.47	42.82	41.05	1.28	11.40	2.14	85.18	.95	997	0	0	0	0	0	0	0
4......	3	2	2.94	....	18.58	10.16	8.08	7.10	1.75	10.75	1.47	86.03	1.07	880	0	0	0	0	0	0	0
5......	2	3	6.03	.186	14.17	8.83	7.62	6.67	....	....	....	....	....	....	0	0	0	0	0	0	0
5......	3	3	3.92	.252	30.06	19.01	14.94	12.06	1.98	17.87	10.50	69.65	1.90	3,337	0	0	0	0	0	0	0
7......	2	2	5.73	....	25.15	15.01	13.02	11.71	.65	8.68	1.12	89.55	.29	585	0	0	0	0	0	0	0
7......	3	2	2.37	.221	22.47	13.30	10.37	8.57	2.53	14.02	0	83.45	2.56	1,003	0	0	0	0	0	0	0
8......	2	2	2.13	....	39.36	27.71	23.93	21.82	2.10	13.60	5.52	78.78	3.76	1,454	0	0	0	0	0	0	0
8......	3	2	2.74	....	27.86	20.57	18.09	17.03	2.20	15.05	6.60	76.15	3.01	1,701	0	0	0	0	0	0	0
9......	3	2	3.02	....	37.36	29.39	27.07	25.21	1.60	14.40	8.60	75.40	2.59	2,237	0	0	0	0	0	0	0
100......	2	3	2.90	.065	22.01	13.64	10.76	5.83	5.90	21.85	2.17	70.08	6.70	1,345	0	0	0	0	0	0	0

COMMENTS ON TABULATED DATA.

Compared with the fine dusts the 20-mesh samples developed relatively low pressures. The highest pressure recorded on this class of samples was 3.8 pounds. Eight samples out of 190 gave pressures of 1 pound or more. Approximately 40 per cent of the 20-mesh samples developed no measurable pressure, and 80 per cent of the samples gave pressures of less than 0.5 pound. In the small laboratory apparatus the low relative inflammability of the 20-mesh samples is, of course, due to the large proportion of coarse particles that do not take part in the explosion.

As regards most of the samples the inflammability of the 200-mesh part of the original sample did not differ greatly from the inflammability of the part of the original sample ground to pass a 200-mesh sieve. About 70 per cent of the 200-mesh parts gave pressures of 0.5 pound or more, and might therefore give rise to explosions.

As regards the relation between the source of the sample in the mine and the inflammability of the dust, the greater the distance from the working face the higher is the ash content and the lower the inflammability of the sample. The room samples are the most inflammable, and the dust from the main entries is the least inflammable. The 200-mesh part of the room sample from each of 59 out of 70 mines developed a pressure of 0.5 pound, and of these every one but two developed a pressure of 1 pound or more. Rib-dust samples collected near the working face had practically the same composition and inflammability as the face samples.

QUANTITY OF RIB DUST IN MINES.

It is important to know whether enough dust adheres to the ribs to propagate an explosion by itself, that is, without the assistance of gas or of road dusts.

Taffanel has found that the minimum dust density that will regularly propagate an explosion is 0.07 ounce per cubic foot (70 grams per cubic meter), though in one test he obtained propagation with a density as low as 0.023 ounce per cubic foot. In experiments in the 100-foot gallery at the Bureau of Mines experiment station at Pittsburgh, Pa., propagation occurred in two instances with a dust density of 0.032 ounce per cubic foot. If it be assumed that all the dust on the rib is put into suspension, and if the average height and width of a room be taken as 7 feet and 24 feet, then in no case was the quantity of dust 20-mesh fine found on ribs in rooms sufficient to produce a density of 0.07 ounce per cubic foot. However, large quantities of fine coal dust resting on the floor or on the gob in rooms might be dangerous, even though the quantity of rib dust was small.

As regards the dust fine enough to pass a 20-mesh screen, for about one-fourth of the samples of rib dust collected in the entries, the quantity was sufficient to yield a dust density of 0.07 ounce per cubic foot, if the entries are assumed to be 7 feet high and 8 feet wide.

In drawing conclusions from the results obtained in the study of the rib dusts, the reader should remember that the deposits of dust on the ribs vary greatly in character and in quantity, from point to point in a mine, and that the results obtained from two or three samples are not necessarily representative of the entire mine.

INFLAMMABILITY OF MINE-ROAD DUSTS.

TABULATED RESULTS.

The results of the laboratory examination of the road dusts are presented in Table 3. The data are arranged in the same manner as the rib-dust data in Table 2.

TABLE 3.—*Results of analyses and of inflammability tests of road dusts.*

Mine No.	Place of sampling.[a]	Seam.	Air-drying loss.	Results of sizing tests.				Approximate analysis.					Calorific value.	Pressure from—						
				Dust through a 20-mesh sieve.	Dust through a 60-mesh sieve.	Dust through a 100-mesh sieve.	Dust through a 200-mesh sieve.	H_2O.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.		Dust through a 20-mesh sieve at a coil temperature of 1200 °C.	Dust through a 200-mesh sieve at a coil temperature of 1200° C.	Ground dust through a 200-mesh sieve at a coil temperature of— 800° C.	900° C.	1000° C.	1100° C.	1200° C.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*B.t.u.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*
71......	2	6	6.01	61.94	39.20	28.34	21.60	3.53	35.17	36.97	24.33	4.00	9,763	....	....	0	0.7	1.0	7.2	7.9
43......	1	5	6.32	35.12	19.18	13.33	8.13	3.40	30.35	46.56	19.69	2.80	10,431	0	1.4	0	.2	1.2	5.8	6.8
66......	2	6	13.07	25.87	11.01	6.99	3.67	3.13	33.92	39.63	23.32	3.93	10,049	0	3.9	0	.3	2.4	5.9	6.8
88......	1	6	2.93	38.04	20.74	12.91	9.89	4.73	35.42	38.60	21.25	3.12	10,359	....	....	0	.3	1.6	6.0	6.8
49......	1	5	4.22	49.43	28.96	22.73	16.06	2.53	31.87	41.40	24.20	4.90	10,089	.4	2.3	0	.3	1.2	5.8	6.6
75......	2	6	9.10	39.20	22.50	17.20	11.60	3.35	28.10	29.73	38.82	3.49	7,731	.2	2.3	0	.3	1.7	5.2	6.5
85......	2	6	6.73	42.23	23.02	16.89	12.26	5.58	30.37	37.37	26.68	3.30	9,117	....	....	0	.2	1.2	5.8	6.5
63......	1	6	2.81	39.39	22.06	17.00	12.48	5.33	34.08	43.66	16.93	2.67	10,895	....	....	0	.5	.9	3.7	6.3
76......	2	6	7.38	39.28	20.60	14.56	10.44	4.05	30.35	33.90	31.70	3.52	8,674	0	1.4	0	.3	1.6	5.4	6.3
14......	1	2	13.52	15.63	2.47	1.23	.61	3.13	29.07	44.62	23.18	1.81	10,363	0	1.4	0	.3	1.6	5.6	6.2
80......	2	6	2.40	33.94	15.86	12.30	8.61	5.05	32.48	34.22	28.25	3.24	9,081	....	....	0	.2	1.0	5.2	6.2
6......	2	2	....	....	....	....	....	2.75	29.73	25.07	42.45	2.06	7,484	....	....	0	.2	1.1	5.1	5.9
84......	1	6	6.54	62.34	42.37	33.54	25.53	4.20	30.35	32.78	32.67	3.74	8,314	....	....	0	.5	1.7	4.9	5.9
13......	1	2	11.17	14.25	4.82	3.14	1.88	3.68	30.12	49.57	16.63	1.53	11,232	.0	1.4	0	.3	1.2	4.9	5.8
15......	2	2	9.72	1.26	.35	.18	.10	2.30	27.60	42.02	28.08	2.35	9,725	.2	1.4	0	.2	1.2	4.5	5.8
86......	2	6	5.27	43.10	21.92	15.61	10.48	4.25	28.30	32.20	35.25	3.35	8,231	.2	< .9	0	.2	1.0	5.1	5.8
32......	1	5	9.13	44.59	21.90	14.21	9.26	5.35	31.10	35.10	28.45	4.44	8,957	.4	3.9	0	.2	1.2	4.5	5.6
66......	1	6	8.53	37.91	23.48	18.27	14.14	4.05	32.50	35.40	28.05	4.58	8,467	.2	< .9	0	0	.7	3.8	5.6
68......	2	6	....	....	....	....	....	5.08	30.52	32.90	31.50	3.80	8,240	....	....	0	.2	1.2	4.9	5.6
38......	2	5	5.20	37.47	24.22	18.11	10.66	5.30	31.40	30.05	33.25	3.59	8,307	0	4.4	0	.2	1.2	4.0	5.4
43......	2	5	2.93	46.63	21.18	14.99	11.27	1.93	24.82	35.80	37.45	2.64	8,446	0	1.4	0	0	.5	4.0	5.4
87......	2	6	4.19	41.25	22.29	17.08	11.97	4.23	32.12	36.96	26.69	3.50	9,497	0	1.4	0	.2	.7	4.4	5.4
3......	1	2	6.98	51.46	31.13	23.26	15.93	3.65	27.85	26.10	42.40	3.95	6,979	0	< .9	0	0	.9	4.4	5.2
26......	2	5	9.40	32.18	18.34	13.52	9.69	3.20	30.55	26.40	39.85	3.18	7,763	0	1.4	0	.2	1.0	3.3	5.2
65......	1	6	10.73	24.18	9.61	6.93	4.81	4.60	32.14	39.70	23.56	2.45	10,174	.5	4.4	0	.2	.7	3.0	5.2
77......	1	6	6.01	32.56	19.42	14.88	11.16	4.63	28.62	25.88	40.87	4.01	6,973	0	< .9	0	0	1.0	3.8	5.2

75	1	6	8.00	51.40	36.00	18.50	11.60	4.50	27.35	32.35	35.80	4.69	7,420	0	< .9	0	.2	.7	3.7	5.0
11	2	2	7.77	48.19	29.11	28.31	17.16	2.18	34.77	17.65	45.40	3.20	6,936	....	....	0	.2	.5	3.3	4.7
77	2	6	7.90	44.99	23.93	18.33	13.00	4.23	27.57	29.56	38.64	3.50	7,472	0	< .9	0	0	.7	3.5	4.7
88	2	6	4.01	30.99	16.07	12.68	7.97	4.55	29.73	35.82	29.90	2.93	8,937	....	....	0	.2	1.2	3.3	4.7
29	2	5	14.24	63.09	38.19	30.63	7.56	3.00	28.60	24.30	44.10	2.99	7,205	0	1.4	0	0	.5	3.2	4.5
57	2	6	4.70	41.61	20.06	14.82	10.84	3.95	26.27	40.61	29.17	1.02	9,331	....	....	0	0	.5	2.8	4.5
73	2	6	5.95	48.91	25.95	18.63	13.64	4.33	26.72	31.05	37.90	3.42	7,394	0	< .9	0	0	.7	3.0	4.5
85	1	6	5.29	41.56	24.28	18.31	12.73	6.66	30.87	39.82	22.65	3.73	9,364	0	< .9	0	0	.5	3.0	4.5
90	1	6	6.68	28.09	12.45	8.03	4.16	3.82	27.16	31.83	37.19	3.49	7,810	....	....	0	0	.7	3.5	4.5
37	1	5	9.67	45.16	25.07	18.28	12.27	4.75	28.85	30.90	35.50	4.24	7,553	.2	< .9	0	0	.7	3.4	4.4
83	1	6	3.36	47.97	28.58	21.89	15.34	5.85	29.80	31.27	33.08	3.42	7,970	0	1.4	0	0	.5	2.8	4.4
65	2	6	13.53	21.56	11.12	9.21	7.30	4.42	32.39	41.40	21.79	2.88	10,289	.2	< .9	0	.2	1.2	2.8	4.2
45	2	5	6.42	46.03	24.73	17.69	12.45	3.10	28.05	45.62	23.23	3.07	10,327	0	< .9	0	0	.5	3.3	4.0
80	1	6	3.22	37.68	20.50	15.44	12.25	5.72	29.58	28.25	36.45	4.04	7,621	....	....	0	0	.5	3.1	4.0
72	2	6	9.24	51.85	30.25	21.29	14.81	5.30	29.35	34.10	31.25	3.80	8,024	0	< .9	0	.2	.5	2.3	4.0
74	2	6	4.99	37.70	22.67	16.94	12.76	7.18	31.07	33.45	28.30	4.79	7,792	0	< .9	0	0	.3	1.4	3.8
9	2	2	7.95	49.13	29.17	22.84	17.08	2.65	26.65	23.00	47.70	4.23	6,167	0	< .9	0	0	.3	1.4	3.7
27	2	5	12.06	56.93	31.66	22.96	15.62	2.88	26.87	19.05	51.20	2.83	5,931	0	1.4	0	.2	.3	1.6	3.7
28	2	5	11.22	73.10	50.00	23.10	15.34	2.83	29.77	19.22	48.18	2.81	6,244	0	< .9	0	0	.3	2.1	3.3
67	1	6	4.71	39.12	23.56	17.36	13.12	6.00	28.90	31.25	33.85	3.79	7,450	0	< .9	0	0	.5	1.4	3.3
57	1	6	11.19	23.53	8.07	5.21	3.19	4.73	28.65	44.37	22.25	.98	10,085	....	....	0	0	.3	1.1	3.1
37	2	5	7.94	32.07	13.62	8.10	4.48	4.38	24.72	25.67	45.23	3.51	6,680	0	1.4	0	0	.2	1.0	3.0
74	1	6	6.34	39.41	21.86	15.63	12.15	6.68	30.02	34.35	28.95	4.40	8,096	0	< .9	0	0	.2	1.2	3.0
25	2	5	9.69	44.21	25.54	18.56	12.61	2.38	23.37	17.05	57.20	2.74	5,396	0	1.4	0	0	.2	1.0	2.9
34	2	5	10.91	54.95	29.01	21.08	13.87	4.23	26.62	24.47	44.68	3.94	6,494	0	< .9	0	.2	.3	.6	2.8
28	1	5	11.83	26.40	10.60	6.27	3.46	3.15	26.40	21.85	48.60	2.79	6,403	0	< .9	0	0	.2	.7	2.5
60	1	6	6.79	34.00	15.14	10.28	8.43	7.02	31.42	47.53	14.03	1.67	10,931	.2	< .9	0	.2	.9	1.0	2.3
68	1	6	....	....	....	....	....	7.58	34.22	28.55	29.65	4.01	7,643	....	....	0	0	.3	1.6	2.3
59	1	6	3.70	43.55	24.62	18.81	13.82	5.83	31.20	44.60	18.37	1.60	10,762	0	< .9	0	.2	.7	.9	2.3
10	2	2	8.40	38.72	23.72	17.03	12.37	2.95	23.80	19.12	54.13	3.57	5,375	0	< .9	0	0	.2	.7	2.3
6	1	2	....	....	....	....	....	2.28	22.52	21.77	53.43	1.61	5,773	0	< .9	0	0	.2	.9	2.2
56	2	6	4.27	45.61	25.03	18.15	12.80	5.18	31.32	40.58	22.92	1.65	10,166	....	....	0	.2	.4	.9	2.1
71	1	6	6.22	34.58	20.00	15.42	11.08	4.13	29.02	27.45	39.40	6.46	6,809	0	6.2	0	0	.2	1.0	2.1
33	2	5	9.83	37.91	19.65	13.61	9.39	3.90	27.00	23.90	45.20	3.32	6,743	0	1.4	0	0	.2	1.0	2.1
25	1	5	10.78	38.64	21.80	16.49	11.52	3.64	24.81	23.34	48.21	4.30	6,311	0	< .9	0	0	.2	.3	2.1
49	2	5	3.39	32.04	17.17	11.36	7.61	2.33	21.32	24.33	52.02	3.46	6,145	0	< .9	0	0	.2	.4	1.9
59	2	6	4.28	30.31	25.83	20.43	15.27	5.59	28.15	39.34	26.92	1.39	9,383	0	1.4	0	.3	.5	.8	1.9
5	2	2	9.77	52.87	37.27	33.33	28.73	1.88	21.92	20.72	55.48	1.46	5,553	....	....	0	0	.0	.3	1.7
39	2	5	5.41	48.20	26.96	20.36	14.93	5.03	26.72	21.50	46.75	3.80	6,338	0	< .9	0	0	.0	.3	1.7
53	1	6	4.54	27.09	12.83	9.35	6.49	6.64	29.92	45.73	17.71	.46	10,726	....	....	0	.2	.3	.5	1.7
63	2	6	5.86	44.95	25.90	21.66	15.63	5.43	29.99	42.39	22.19	1.50	10,134	....	....	0	.3	.7	1.0	1.6
70	2	6	5.06	46.22	25.13	18.88	12.37	4.38	27.52	25.75	42.35	4.46	6,514	.2	< .9	0	0	.0	.5	1.6
92	1	6	7.66	22.77	9.25	8.06	2.01	4.48	22.65	29.87	43.00	2.00	6,953	0	.2	0	0	.2	.7	1.6
91	2	6	6.40	34.63	18.31	5.89	2.84	4.90	24.13	27.87	43.10	2.01	6,943	0	.2	0	0	.2	.7	1.4
48	1	5	12.64	18.30	7.02	5.10	3.40	2.63	20.17	27.32	49.88	1.87	6,329	0	< .9	0	0	.1	.5	1.2
83	2	6	4.74	34.60	16.35	11.25	7.06	6.30	26.40	25.20	42.10	3.74	6,430	0	< .9	0	0	0	.3	1.2
89	2	6	16.25	43.10	30.40	25.70	21.20	2.12	14.43	11.42	72.03	1.08	3,002	....	....	0	0	0	.3	1.2
21	2	3	4.21	51.18	32.65	25.27	17.58	2.90	22.80	24.50	49.80	2.60	6,194	0	< .9	0	0	0	.3	1.0
29	1	5	7.13	75.55	52.21	28.37	18.96	3.15	24.25	15.95	56.65	4.16	5,049	0	< .9	0	0	.2	.5	1.0
53	2	6	4.51	40.97	19.72	14.58	10.27	5.36	28.24	41.97	24.43	.50	9,868	....	....	0	0	.3	.5	1.0

a Figure 1 indicates that sample was taken from the secondary haulageway, and figure 2, that sample was taken from the main haulageway.

TABLE 3.—*Results of analyses and of inflammability tests of road dusts*—Continued.

Mine No.	Place of sampling.	Seam.	Air-drying loss.	Results of sizing tests. Dust through a 20-mesh sieve.	Dust through a 60-mesh sieve.	Dust through a 100-mesh sieve.	Dust through a 200-mesh sieve.	Approximate analysis. H_2O.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calorific value.	Pressure from Dust through a 20-mesh sieve at a coil temperature of 1200° C.	Dust through a 200-mesh sieve at a coil temperature of 1200° C.	Ground dust through a 200-mesh sieve at a coil temperature of— 800° C.	900° C.	1000° C.	1100° C.	1200° C.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*B.t.u.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*
24	1	1	12.33	35.10	13.35	8.98	4.25	4.33	26.22	20.37	49.08	5.21	5,348	0	.3	0	0	.2	.5	1.0
91	1	6	13.68	15.85	4.69	1.95	.97	4.70	25.10	32.42	37.78	1.56	7,693	0	.2	0	0	0	.3	1.0
18	1	1	21.48	5.66	1.88	1.15	.63	2.78	24.60	13.86	58.76	3.95	4,835	0	.2	0	0	0	0	.9
41	2	5	8.25	65.09	36.19	25.48	16.49	5.50	26.70	25.55	42.25	3.05	6,647	.2	.9	0	0	0	.2	.9
69	2	6	9.73	54.73	28.89	19.70	12.78	4.33	24.87	25.43	45.37	3.48	6,343	.2	1.4	0	0	0	.2	.9
70	1	6	6.59	40.47	23.88	18.94	13.76	4.90	27.05	18.42	49.63	5.11	5.020	0	.9	0	0	.2	.5	.9
97	2	7	15.70	11.09	3.30	1.85	.79	3.55	22.30	25.75	48.40	1.26	6,235	0	.2	0	0	0	.3	.7
45	1	5	7.38	29.02	12.93	8.12	4.81	2.98	23.57	35.47	37.98	3.18	7,628	0	.9	0	0	0	.2	.7
60	2	6	4.19	40.96	17.84	12.57	8.64	4.62	25.97	34.43	34.98	1.65	8,296	......	......	0	0	.2	.3	.7
27	1	5	11.04	28.27	11.72	8.05	4.37	3.90	21.30	18.75	56.05	2.51	5,110	0	.9	0	0	0	.3	.6
17	1	1	6.52	18.62	8.06	4.10	2.61	7.15	31.30	12.32	49.23	8.84	4,374	0	0	0	0	0	0	.5
15	1	2	13.00	3.18	.72	.53	.38	2.85	22.40	33.35	41.40	2.95	7,141	0	.9	0	0	0	0	.5
36	1	5	7.91	26.02	10.77	9.74	5.90	3.95	22.05	21.25	52.75	3.49	4,855	0	.9	0	0	0	0	.5
49	1	5	8.97	38.39	20.36	11.91	9.85	4.80	21.05	22.59	51.56	3.36	5,051	0	.9	0	0	0	0	.5
40	2	5	7.35	47.50	23.58	17.00	10.88	3.53	21.62	11.50	63.35	3.03	3,841	0	.9	0	0	0	0	.5
41	1	5	6.10	30.04	17.03	12.74	8.58	5.85	23.85	22.22	48.08	3.59	5,657	0	.9	0	0	0	0	.5
42	1	5	4.29	39.57	23.09	17.28	12.13	4.30	21.50	25.60	48.60	2.50	6,018	0	.9	0	0	0	0	.5
42	2	5	4.91	55.34	36.97	18.25	12.84	5.33	19.42	18.25	57.00	2.57	4,563	0	.9	0	0	0	0	.5
44	1	5	4.91	16.34	5.16	3.07	1.72	2.25	19.40	25.60	52.75	4.78	5,656	0	.9	0	0	0	0	.5
67	2	6	6.62	36.93	18.73	14.29	9.84	4.80	24.25	23.02	47.93	3.76	5,499	0	.9	0	0	0	0	.5
79	1	6	6.59	42.55	12.55	6.67	3.33	3.48	22.97	15.65	57.90	4.38	4,720	0	2.3	0	0	0	0	.5
87	1	6	3.83	43.07	24.95	19.26	12.80	5.45	26.00	29.87	38.68	4.40	6,709	0	.9	0	0	0	0	.5
44	2	5	5.45	28.37	9.56	5.91	3.18	1.55	16.30	20.60	61.55	1.67	5,116	0	.9	0	0	0	0	.4
1	1	2	4.52	42.39	27.64	21.37	16.99	2.63	17.67	11.20	68.50	3.53	3,425	......	......	0	0	0	0	.3
2	1	2	7.50	47.38	27.88	20.94	15.05	2.65	20.55	18.27	58.53	3.01	4,711	0	.9	0	0	0	0	.3
9	1	2	7.37	33.29	19.10	13.52	10.21	2.73	20.32	15.80	61.15	3.72	3,992	0	.9	0	0	0	0	.3

10......	1	2	8.47	44.21	25.05	18.53	13.89	1.75	15.00	7.42	75.83	3.93	2,444	0	< .9	0	0	0	0	.3
13......	2	2	9.10	38.73	11.35	6.34	1.83	1.77	12.93	14.11	71.19	.86	3,739	.2	< .9	0	0	0	0	.3
21......	1	3	42.96	43.51	33.45	21.94	9.86	2.00	12.00	20.00	77.80	1.36	2,430	0	< .9	0	0	0	0	.3
26......	1	5	7.45	33.61	20.13	13.29	7.77	3.70	20.45	12.15	63.70	3.77	3,940	0	< .9	0	0	0	0	.3
31......	1	5	8.48	35.21	18.53	13.65	10.14	3.70	21.00	18.85	56.45	4.04	5,025	0	< .9	0	0	0	0	.3
38......	1	5	7.76	39.43	21.93	16.02	11.14	4.21	19.96	17.84	57.99	3.99	4,183	0	< .9	0	0	0	0	.3
39......	1	5	7.42	37.02	19.66	14.22	9.64	6.30	21.25	16.85	55.60	4.42	4,149	0	< .9	0	0	0	0	.3
47......	1	5	1.49	1.99	.59	.31	.18	3.33	20.27	18.15	58.25	3.15	4,950	0	< .9	0	0	0	0	.3
56......	1	6	3.12	56.20	37.84	30.64	24.19	4.97	23.91	27.07	44.05	1.11	6,811	....	....	0	0	0	.2	.3
69......	1	6	7.64	42.23	22.17	16.00	10.38	4.60	20.10	19.57	55.73	3.20	4,671	0	< .9	0	0	0	0	.3
73......	1	6	8.43	17.78	7.32	4.60	2.93	5.25	22.80	13.50	58.45	4.21	4,221	0	< .9	0	0	0	0	.3
78......	1	6	8.72	27.40	10.53	6.60	3.51	5.03	18.67	16.72	59.58	2.95	4,054	0	< .9	0	0	0	0	.3
79......	2	6	....	....	....	....	....	1.85	11.85	10.21	76.09	1.32	3,116	....	....	0	0	0	0	.3
19......	1	1	42.87	20.77	4.28	1.81	.90	3.53	22.70	6.09	67.68	3.67	3,616	0	.2	0	0	0	0	.3
92......	2	6	13.73	16.63	4.83	1.79	.35	5.00	25.58	30.59	38.83	1.54	7,306	0	.1	0	0	0	0	.3
93......	2	6	16.92	11.52	3.70	2.88	1.44	2.73	20.10	15.74	61.43	1.03	4,437	0	0	0	0	0	.2	.3
1.......	2	2	4.71	49.84	30.89	23.68	17.43	2.23	12.47	4.45	80.85	2.78	1,285	....	....	0	0	0	0	.3
93......	1	6	6.62	42.54	27.75	15.03	3.66	3.28	18.02	18.52	60.18	1.50	4,622	0	0	0	0	0	0	.2
97......	1	6	5.75	42.52	25.12	9.66	6.00	4.03	18.25	18.94	58.78	1.51	4,759	0	0	0	0	0	0	.2
4.......	1	2	4.87	29.88	17.66	12.95	9.92	1.33	10.70	2.02	85.95	.76	1,055	....	....	0	0	0	0	.2
4.......	2	2	5.11	55.41	36.81	29.07	23.23	2.05	19.85	14.77	63.33	2.12	4,111	0	.9	0	0	0	0	.2
5.......	1	2	9.78	42.55	31.10	28.01	27.77	1.40	13.65	8.35	76.60	.91	2,488	....	....	0	0	0	0	.2
7.......	1	2	7.62	77.44	27.61	21.89	6.27	1.85	14.35	8.72	75.08	1.84	2,223	....	....	0	0	0	0	.2
7.......	2	2	5.71	40.15	24.84	17.57	14.84	1.88	14.72	7.92	75.48	1.67	2,261	....	....	0	0	0	0	.2
8.......	1	2	2.79	28.59	15.10	11.36	7.86	1.95	13.05	5.70	79.30	3.41	1,712	0	< .9	0	0	0	0	.2
8.......	2	2	4.82	44.41	26.23	20.12	15.94	2.40	19.30	15.85	62.45	3.34	3,967	0	< .9	0	0	0	0	.2
11......	1	2	7.11	47.59	25.84	20.14	16.93	2.23	18.57	16.55	62.65	2.21	4,235	....	....	0	0	0	0	.2
12......	1	2	16.06	16.44	5.39	3.50	1.89	2.15	13.80	14.80	69.25	1.32	3,377	0	< .9	0	0	0	0	.2
36......	2	5	5.93	42.03	21.92	15.91	10.66	5.50	19.80	16.22	58.48	3.63	3,915	0	< .9	0	0	0	0	.2
72......	1	6	8.47	44.21	25.05	18.53	13.89	4.70	21.40	14.40	59.50	3.67	3,913	0	< .9	0	0	0	0	.2
76......	1	6	....	....	....	....	....	4.65	12.55	2.55	80.25	3.03	1,303	0	< .9	0	0	0	0	.2
89......	1	6	18.65	35.30	21.35	18.30	14.60	2.93	17.57	13.60	65.90	1.27	3,757	....	....	0	0	0	0	.2
100.....	2	6	5.77	42.86	23.70	17.27	11.77	3.35	20.85	13.85	61.95	4.06	3,548	0	0	0	0	0	0	.2
34......	1	5	6.52	36.33	18.89	14.28	9.67	4.83	15.97	5.40	73.80	5.09	1,939	0	< .9	0	0	0	0	0
100.....	1	6	6.20	38.82	18.75	12.86	8.41	2.85	15.05	2.75	79.35	4.18	1,096	0	< .9	0	0	0	0	0
95......	1	6	25.07	10.82	5.11	2.75	1.17	5.15	12.48	3.74	78.63	.68	1,693	0	0	0	0	0	0	0

COMMENTS ON TABULATED DATA.

The average proportion of each road-dust sample that was fine enough to pass a 20-mesh screen was 39 per cent. With few exceptions the minimum proportion passing a 20-mesh screen was 20 per cent. Less than half of the dust through a 20-mesh sieve, an average of 15.5 per cent of the original samples, passed a 100-mesh screen, and 10.5 per cent passed a 200-mesh screen.

The last column of Table 3 gives the pressures obtained at 1,200° C. with parts of the road dusts that were ground to pass a 200-mesh screen. A comparison of these values with those in the last column of Table 2 shows that the road dusts are relatively less inflammable than the rib dusts—a result that one would expect because of the

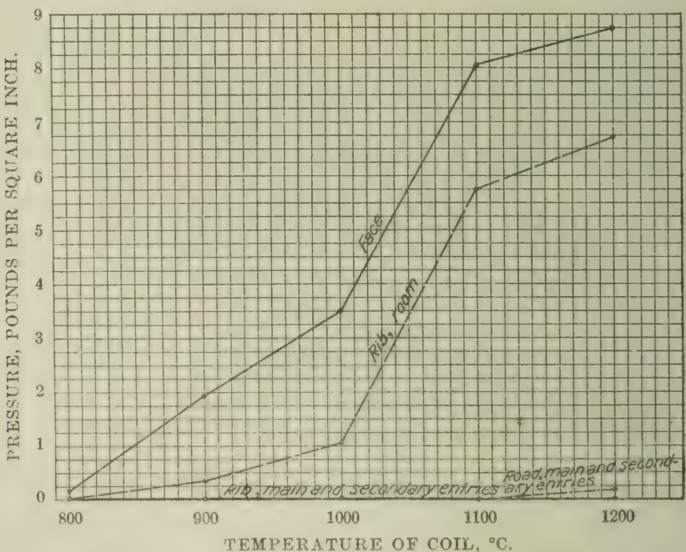


FIGURE 9.—Inflammability curves for all samples from mine No. 8.

higher ash content of the road dusts. The greater number of the ground parts of the road dusts, however, developed pressures of 0.5 pound or more, indicating that the material composing the road dusts of many Illinois mines, when reduced to the proper degree of fineness, can propagate and even give rise to a dust explosion.

The highest pressure developed in the inflammability apparatus by the 20-mesh samples was 0.5 pound, and in the majority of tests no pressure was developed. As the road dusts contained such a small proportion of dust fine enough to pass a 200-mesh screen, it is not surprising that their inflammability is so low.

The pressures developed by the 200-mesh parts of the road-dust samples are reported in column 16. In most of these samples the

pressure is reported as <0.9. Most samples that did not develop sufficient pressure (0.9 pound per square inch) to raise a weight of 25 grams were not tested with smaller weights on the pressure-

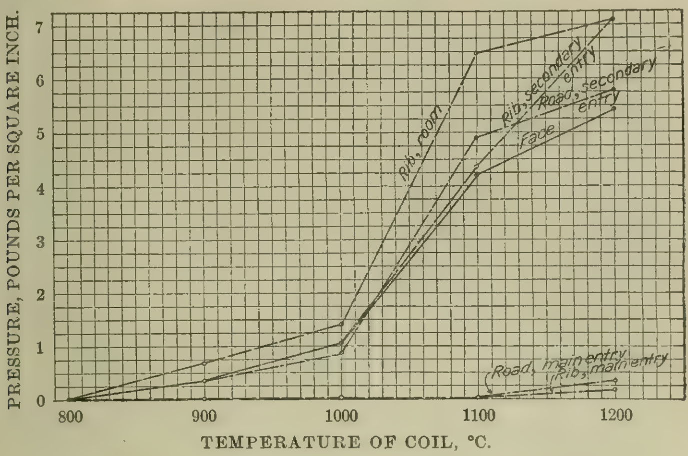


FIGURE 10.—Inflammability curves for all samples from mine No. 13.

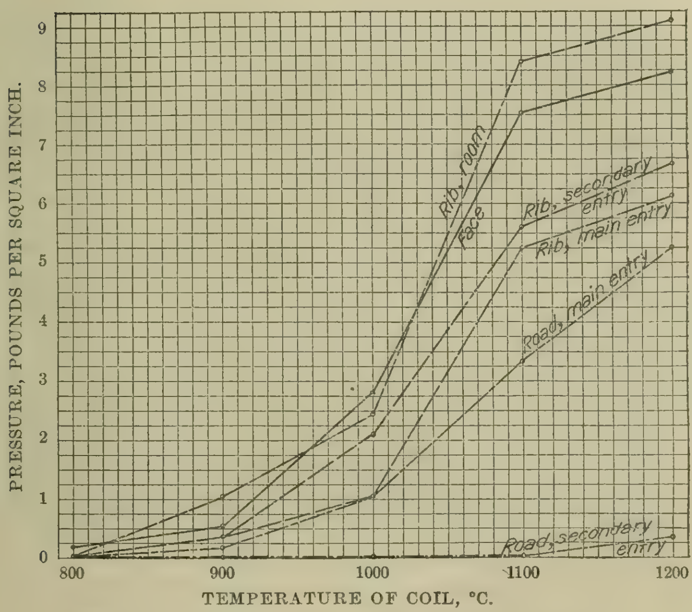


FIGURE 11.—Inflammability curves for all samples from mine No. 26.

measuring device, as it was not expected that dusts that developed so little pressure in the laboratory apparatus would serve to propagate an explosion. At the time the experimental work was done it was

not known that dusts that developed as low a pressure as 0.5 pound per square inch in the laboratory apparatus would under favorable conditions give rise to a dust explosion in the mine.

In the study of the rib dusts it was found that the inflammability of most of the 200-mesh parts of the unground samples was only

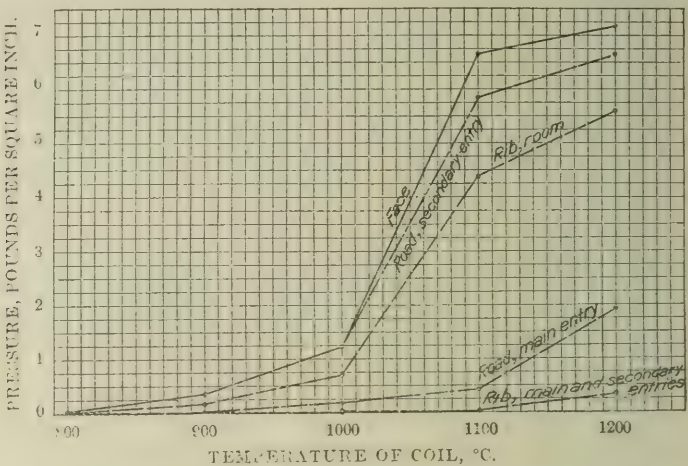


FIGURE 12.—Inflammability curves for all samples from mine No. 49.

slightly less than that of samples ground to 200-mesh size in the laboratory. The question arises: Why does the same relation not obtain for the road dusts? The reason for the difference is not evident. The low inflammability of the sized part of the road dusts

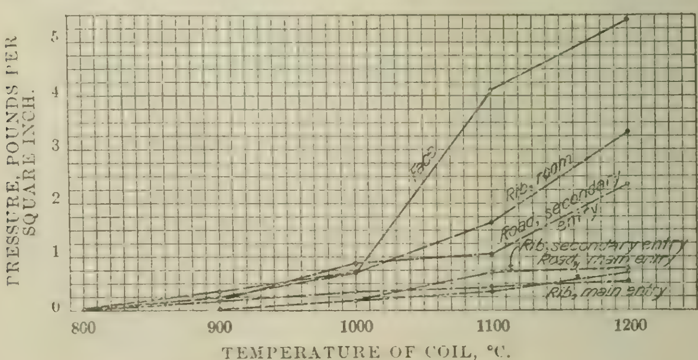


FIGURE 13.—Inflammability curves for all samples from mine No. 69.

may be due to an excess of ash in the finer particles of road dust, though there is no reason for expecting such a selective distribution of ash. A more probable explanation is that the grinding of the dusts in the laboratory produces a larger proportion of extremely fine dust particles than is present in the road dusts of the mine.

No variation of inflammability of the road dusts with the locality in the mine is evident. Among samples whose inflammability is high, as many are from the main entries as from other entries.

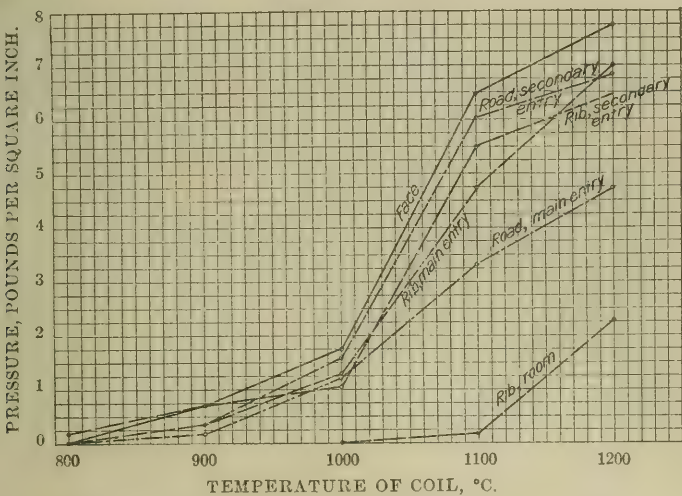


FIGURE 14.—Inflammability curves for all samples from mine No. 83.

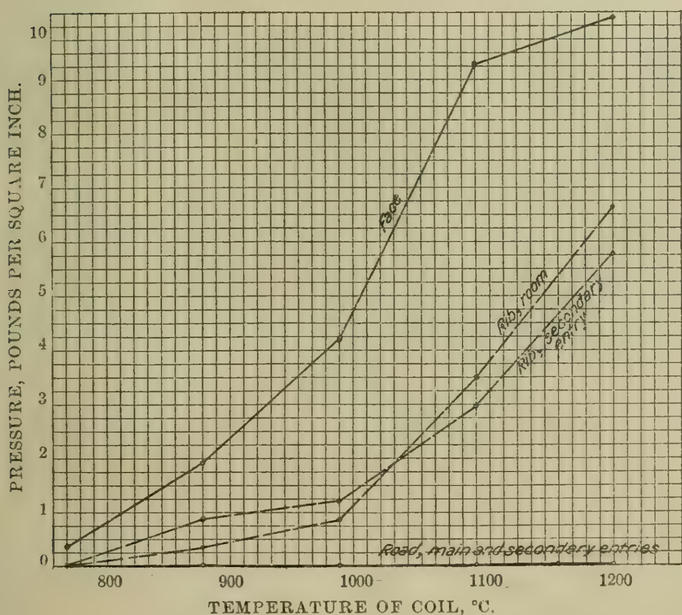


FIGURE 15.—Inflammability curves for all samples from mine No. 95.

If the pressures developed by the 20-mesh and the 200-mesh parts and by the parts of the road dusts ground to pass a 200-mesh screen be compared with the pressures developed by similar parts of the

rib dusts, it will be found that in every case the rib dusts were the more inflammable. And the difference is in the direction one should expect from the difference in the ash content.

Although the laboratory tests demonstrate clearly that in general the road dusts of Illinois mines, when ground to pass a 200-mesh screen, are capable of forming an explosive mixture with air, the results of the tests of the unground dusts are not so conclusive. It would be wrong to conclude from the low pressures developed by the unground samples of road dust that road dusts are not capable of taking part in explosions. Dusts that are too coarse to produce an explosion in the laboratory may propagate an explosion in a mine. In experiments in the large steel explosion gallery of the bureau's Pittsburgh experiment station, dust through a 40-mesh and over a 60-mesh screen propagated an explosion the entire length of the gallery.[a]

To show the relation between the inflammability of the several kinds of samples collected in each mine, inflammability curves for all of the samples from each one of a number of different mines have been drawn on the same sheet. These curves are shown in figures 9 to 15, inclusive.

INFLAMMABILITY OF DUSTS OF EIGHT DISTRICTS.

In the paragraphs immediately preceding, the results of the study of the inflammability of the dusts of Illinois mines have been considered without regard to the geographical situation of the mines. Inasmuch as different beds of coal are worked in different districts of the State, and by different methods of mining, it is reasonable to expect dusts from these districts to differ in inflammability.

To facilitate the comparison of the dusts of the various districts, the more important of the data contained in Tables 1, 2, and 3 have been assembled in Table 4, in which the results are arranged in groups by districts. The pressures reported in the table were all obtained at a coil temperature of 1,200° C.

[a] See Rice, G. S., and others, The explosibility of coal dust: Bull. 20, Bureau of Mines, p. 43.

TABLE 4.—*Combined data on face, rib-dust, and road-dust samples from mines in various Illinois districts.*

DISTRICT 1.

Mine No.	Source of sample.[a]	Face samples. Proximate analysis (air-dried sample). Moisture.	Volatile matter.	Ash.	Calorific value.	Pressure at 1,200° C.	Rib-dust samples. Proximate analysis (air-dried sample). Moisture.	Volatile matter.	Ash.	Calorific value.	Dust through a 200-mesh sieve.	Dust per square foot through a 200-mesh sieve.	Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Dust through a 200-mesh sieve.	Ground dust through a 200-mesh sieve.	Road-dust samples. Proximate analysis (air-dried sample). Moisture.	Volatile matter.	Ash.	Calorific value.	Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Dust through a 200-mesh sieve.	Ground dust through a 200-mesh sieve.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		P. ct.	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*P. ct.*	*Ounces.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*
1	1	5.20	40.15	9.46	12,078	8.4	2.10	39.80	21.40	10,406	5.47	.0172	0	5.2	8.9	2.63	17.67	68.50	3,425			.3
	2						2.63	17.30	73.60	2,455	12.67	.0427	0	0	0	2.23	12.47	80.85	1,285			0
	3						2.75	16.30	78.40	1,022	8.31	.0274	0	0	0							
2	1	6.78	40.97	9.47	11,808	8.4	7.80	28.15	59.58	1,438	14.73		0	0	0	2.65	20.55	58.53	4,711	0	<.9	.3
	2																					
	3																					
3	1	5.12	41.88	9.68	12,092	8.7	2.10	40.60	22.40	10,771	7.96	.0155	.2	7.9	8.8	3.65	27.85	42.40	6,979	0	<.9	5.2
	2																					
	3																					
4	1	5.67	39.21	7.19	12,539	8.1					1.80		0	4.2	8.2	1.33	10.70	85.95	1,055			.2
	2						1.28	11.40	85.18	997	41.05		0	0	0	2.05	19.85	63.33	4,111	0	<.9	.2
	3						1.75	10.75	86.03	880	7.10		0	0	0							
5	1	6.77	40.63	7.01	12,240	8.0					7.25	.0120	.2	1.7	7.3	1.40	13.65	76.60	2,488			.2
	2										6.67	.0124	0	0	0	1.88	21.92	55.48	5,553			1.7
	3						1.98	17.87	69.65	3,337	12.06	.0304	0	0	0							
6	1	6.87	39.98	6.00	12,290	8.1										2.28	22.52	53.43	5,773	0	<.9	2.2
	2															2.75	29.73	42.45	7,484			5.9
	3																					
7	1	7.24	40.09	5.65	12,433	8.0	1.55	23.38	48.53	6,664	5.32		0	.2	.5	1.85	14.35	75.08	2,223			.2
	2						.65	8.68	89.55	585	11.71		0	0	0	1.88	14.72	75.48	2,261			.2
	3						2.53	14.20	83.45	1,003	8.57	.0189	0	0	0							

[a] In the cace of face samples and rib-dust samples, figure 1 indicates that sample was taken from a room; figure 2, that sample was taken from the secondary haulageway; and figure 3, that sample was taken from the main haulageway. In the case of road-dust samples, figure 1 indicates that sample was taken from the secondary haulageway; and figure 2, that sample was taken from the main haulageway.

TABLE 4.—*Combined data on face, rib-dust, and road-dust samples from mines in various Illinois districts*—Continued.

DISTRICT 1—Continued.

Mine No.	Source of sample.	Face samples. Proximate analysis (air-dried sample). Moisture.	Face: Volatile matter.	Face: Ash.	Face: Calorific value.	Face: Pressure at 1,200° C.	Rib-dust samples. Proximate analysis (air-dried sample). Moisture.	Rib: Volatile matter.	Rib: Ash.	Rib: Calorific value.	Rib: Dust through a 200-mesh sieve.	Rib: Dust per square foot through a 200-mesh sieve.	Rib: Pressure at 1,200° C. of Dust through a 20-mesh sieve.	Rib: Pressure: Dust through a 200-mesh sieve.	Rib: Pressure: Ground dust through a 200-mesh sieve.	Road-dust samples. Proximate analysis (air-dried sample). Moisture.	Road: Volatile matter.	Road: Ash.	Road: Calorific value.	Road: Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Road: Pressure: Dust through a 200-mesh sieve.	Road: Pressure: Ground dust through a 200-mesh sieve.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		P. ct.	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*P. ct.*	*Ounces.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*
8..........	1	5.78	40.52	9.10	12,112	8.7	2.65	34.23	28.13	9,641	5.97	....	0	4.9	6.7	1.95	13.05	79.30	1,712	0	<.9	.2
	2	......	....	......	....	....	2.10	13.60	78.78	1,454	21.82	....	0	0	0	2.40	19.30	62.45	3,967	0	<.9	.2
	3	......	....	......	....	....	2.20	15.05	76.15	1,701	17.03	....	0	0	0	......	....	....	....	......	....	......
9..........	1	4.94	42.06	10.38	11,835	8.9	2.38	41.00	17.80	11,074	7.73	.0255	0	7.0	9.1	2.73	20.32	61.15	3,992	0	<.9	.3
	2	......	....	......	....	....	......	....	....	....	21.94	....	0	.2	4.2	2.65	26.65	47.70	6,167	0	<.9	3.7
	3	......	....	......	....	....	1.60	14.40	75.40	2,237	25.21	....	0	0	0	......	....	....	....	......	....	......
10..........	1	4.28	42.12	7.83	12,465	8.9	......	....	....	....	.74	....	0	.3	6.6	1.75	15.00	75.83	2,444	0	<.9	.3
	2	......	....	......	....	....	1.85	10.90	83.95	1,208	6.50	....	0	0	0	2.95	23.80	54.13	5,375	0	<.9	2.3
	3	......	....	......	....	....	2.90	24.85	50.33	5,591	39.42	....	0	.2	2.3	......	....	....	....	......	....	......
11..........	1	4.52	39.68	9.67	12,373	7.9	......	....	....	....	2.63	.0059	0	.2	5.6	2.23	18.57	62.65	4,235	......	....	.2
	2	......	....	......	....	....	1.30	11.85	80.50	1,757	13.03	....	0	0	0	2.18	34.77	45.40	6,966	......	....	4.7
	3	......	....	......	....	....	2.25	21.32	56.93	4,646	64.16	....	0	0	.2	......	....	....	....	......	....	......
Average	......	5.74	40.66	8.31	12,206	8.4	2.32	20.77	63.29	3,943	14.49	....	......	......	2.6	2.27	19.87	63.33	4,110	......	....	1.4

DISTRICT 2.

12	1	3.72	33.53	7.08	12,906	5.4	2.48	32.82	19.60	10,969	5.20	.0203	.2	4.4	7.3	2.15	13.80	69.25	3,377	0	<.9	.2
	2						2.83	29.77	22.58	10,490	15.88		0	4.7	5.6							
	3																					
13	1	4.32	33.68	5.89	13,075	5.4	2.78	32.80	11.90	12,325	13.02	.0178	.2	5.6	7.1	3.68	30.12	16.63	11,232	0	1.4	5.8
	2						4.05	32.15	13.33	11,309	8.16	.0035	.2	2.3	7.1	1.77	12.93	71.19	3,739	.2	<.9	.3
	3						5.23	31.37	45.13	4,444	21.61	.0303	.2	0	.2							
14	1	5.07	34.33	7.26	12,717	5.8	2.50	33.38	19.51	10,721	17.10	.0501	.3	4.7	5.8	3.13	29.07	23.18	10,363	0	1.4	6.2
	2						4.55	31.30	23.95	8,710	3.96	.0004	0	.7	2.7							
	3																					
15	1	4.35	35.20	5.49	13,115	6.6	2.43	32.52	16.74	11,453	8.99	.0093	0	4.3	7.4	2.85	22.40	41.40	7,141	0	<.9	.5
	2						3.50	32.35	17.75	10,870	12.12	.0128	.2	4.4	7.8	2.30	27.60	28.08	9,725	.2	1.4	5.8
	3						4.60	34.13	29.28	7,114	10.39		.3	.5	.3							
16	1	5.77	34.51	6.04	12,856	5.9																
	2																					
	3																					
Average		4.65	34.25	6.35	12,934	5.8	3.50	32.26	21.98	9,841	11.64				5.1	2.65	22.65	41.62	7,596			3.1

DISTRICT 3.

17	1	4.01	42.04	11.15	11,889	8.4	3.45	37.83	24.70	9,887	3.13	.0042	.2	5.8	7.7	7.15	31.30	49.23	4,374	0	0	.5
	2																					
	3																					
18	1	3.98	40.69	10.97	12,013	8.4	3.00	36.85	23.54	10,184	11.33		.2	7.7	7.5	2.78	24.60	58.76	4,835	0	.2	.9
	2						3.90	28.15	50.35	5,396	29.32		.2	.9	1.2							
	3																					
19	1	4.15	42.30	11.33	11,957	8.0	2.80	36.90	20.95	10,667	12.17		.5	6.8	8.0	3.53	22.70	67.68	3,616	0	.2	.3
	2						5.28	35.50	44.40	63.25	3.25		0	1.9	3.1							
	3																					
20	1																					
	2																					
	3																					
21	1	5.43	40.02	8.24	12,388	7.0										2.00	12.00	77.80	2,430	0	<.9	.3
	2															2.90	22.80	49.80	6,194	0	<.9	1.0
	3																					
22	1	4.03	36.90	9.25	12,452	7.0																
	2																					
	3																					
23	1																					
	2																					
	3																					
24	1						2.55	37.00	22.35	10,710	16.63	.0166	.3	7.2	7.3	4.33	26.22	49.08	5,348	0	.3	1.0
	2						5.00	32.13	34.70	7,290	3.79		.3	1.4	1.9							
	3																					
Average		4.32	40.39	10.19	12,140	7.76	3.71	34.91	31.57	8,637	11.37				5.24	3.78	23.27	58.73	4,466			.7

TABLE 4.—*Combined data on face, rib-dust, and road-dust samples from mines in various Illinois districts*—Continued.

DISTRICT 4.

Mine No.	Source of sample.	Face samples. Proximate analysis (air-dried sample). Moisture.	Face: Volatile matter.	Face: Ash.	Face: Calorific value.	Face: Pressure at 1,200° C.	Rib-dust samples. Proximate analysis (air-dried sample). Moisture.	Rib: Volatile matter.	Rib: Ash.	Rib: Calorific value.	Rib: Dust through a 200-mesh sieve.	Rib: Dust per square foot through a 200-mesh sieve.	Rib: Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Rib: Dust through a 200-mesh sieve.	Rib: Ground dust through a 200-mesh sieve.	Road-dust samples. Proximate analysis (air-dried sample). Moisture.	Road: Volatile matter.	Road: Ash.	Road: Calorific value.	Road: Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Road: Dust through a 200-mesh sieve.	Road: Ground dust through a 200-mesh sieve.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		P. ct.	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*P. ct.*	*Ounces.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*
25..........	1	4.76	40.03	12.43	11,723	7.5	3.35	37.10	15.65	11.428	13.15	.0986	.2	7.2	8.4	3.64	24.81	48.21	6,311	0	< .9	2.1
	2	......	......	......	......	......	4.23	33.50	21.58	10,121	16.00	.0141	.3	6.8	8.2	2.38	23.37	57.20	5.396	0	1.4	2.9
	3	......	......	......	......	......										......	......	......	......	......	......	......
26..........	1	4.94	39.64	12.89	11,563	8.2	3.20	37.70	20.78	10,651	24.73	.0450	.7	6.5	9.1	3.70	20.45	63.70	3,940	0	< .9	.3
	2	......	......	......	......	......	5.30	37.13	27.13	8,962	40.98	.1934	1.4	5.8	6.6	3.20	30.55	39.55	7,763	0	1.4	5.2
	3	......	......	......	......	......	4.00	34.65	35.14	7,879	55.48	.1193	3.5	5.8	6.1	......	......	......	......	......	......	......
27..........	1	4.96	39.72	10.72	11,887	8.7	2.75	38.57	21.73	10.530	7.07	.0265	0	5.9	7.9	3.90	21.30	56.05	5,110	0	< .9	.6
	2	......	......	......	......	......	4.60	37.15	21.10	10.017	6.57	.0118	.2	5.9	7.7	2.88	26.87	51.20	5,931	0	.4	3.7
	3	......	......	......	......	......	5.63	30.87	48.45	5.531	27.63	.0555	.2	.3	.9	......	......	......	......	......	......	......
28..........	1	5.95	39.83	10.87	11,630	8.7	3.00	39.20	17.25	10,823	12.50	.0212	.5	7.3	8.7	3.15	26.40	48.60	6,403	0	< .9	2.5
	2	......	......	......	......	......	6.58	34.07	34.10	7,735	8.50	.0240	0	1.7	4.8	2.83	19.22	48.18	6,244	0	< .9	3.3
	3	......	......	......	......	......					2.20	.0004	0	0	5.9	......	......	......	......	......	......	......
29..........	1	5.66	38.74	11.98	11,500	7.5	2.43	39.07	19.33	10,939	11.43	.0402	1.7	7.2	8.6	3.15	24.25	56.65	5,049	0	< .9	1.0
	2	......	......	......	......	......	4.50	34.60	34.40	7,900	19.09	.0246	.2	.2	5.8	3.00	28.60	44.10	7,205	0	1.4	4.5
	3	......	......	......	......	......	6.20	37.63	26.51	8,924	19.12	.0665	.3	6.6	6.6	......	......	......	......	......	......	......
30..........	1	4.45	39.09	12.89	11,633	7.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	2	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	3	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
31..........	1	5.85	39.65	11.86	11,574	7.3	2.78	40.17	17.60	10.624	5.53	.0362	.2	6.5	8.7	3.70	21.00	56.45	5,026	0	< .9	.3
	2	......	......	......	......	......	3.78	37.52	23.53	9,547	27.07	.0179	.5	5.8	7.9	......	......	......	......	......	......	......
	3	......	......	......	......	......										......	......	......	......	......	......	......
32..........	1	4.55	40.04	13.20	11,749	7.5	2.10	38.08	19.70	11.147	11.69	.0209	.9	8.9	8.6	5.35	31.10	28.45	8,957	.4	3.9	5.6
	2	......	......	......	......	......	5.98	37.62	28.50	8,082	27.68	.1702	.2	3.7	5.3	......	......	......	......	......	......	......
	3	......	......	......	......	......	9.23	39.17	33.08	6,046	18.15	.1425	0	3.7	.3	......	......	......	......	......	......	......

33	1	5.12	38.96	13.50	11,543	8.2	5.15	36.40	21.68	10,237	4.19	.0119	0	4.0	6.5							
	2						7.50	36.78	19.28	9,895	24.67	.0984	.9	3.6	5.9	3.90	27.00	45.20	6,743	0	1.4	2.1
	3						8.00	32.63	29.43	8,077	7.34	.0074	0	.7	1.6							
34	1	4.83	38.92	10.10	11,885	7.9	3.75	37.18	16.30	11,110	9.46	.0232	.2	5.8	7.9	4.83	15.97	73.80	1,939	0	< .9	0
	2						6.45	34.63	24.50	8,996	14.27	.0725	.2	1.7	5.7	4.23	26.62	44.68	6,494	0	< .9	2.8
	3						4.88	32.22	37.55	7,333	13.76	.0105	1.6	2.8	3.6							
35	1																					
	2																					
	3																					
36	1	4.81	39.19	11.56	11,590	7.7	5.40	35.95	18.25	10,570	18.92	.0078	.7	4.5	7.3	3.95	22.05	52.75	4,855	0	< .9	.5
	2						4.33	37.35	16.93	11,005	10.83	.0344	.5	6.5	8.6	5.50	19.80	58.48	3,915	0	< .9	.2
	3						7.55	33.63	27.98	7,992	24.83	.0137	.3	1.6	.9							
37	1	8.08	38.35	11.43	11,090	7.5	4.88	35.40	19.33	10,546	18.56	.0542	.3	5.4	7.0	4.75	28.85	35.50	7,553	.2	< .9	4.4
	2						6.60	33.80	21.78	9,587	24.03	.1692	.3	.5	4.9	4.38	24.72	45.23	6,680	0	1.4	3.0
	3						6.63	32.17	29.53	7,355	25.41	.1804	.2	.2	.5							
38	1	7.58	39.05	11.04	11,315	7.8	4.78	38.50	17.64	10,706	13.50	.0305	.7	6.3	8.0	4.21	19.96	57.99	4,183	0	< .9	.3
	2						7.38	33.05	21.55	9,164	24.36	.2356	.2	3.1	5.4	5.30	31.40	33.25	8,307	0	4.4	5.4
	3						4.28	26.55	42.73	7,022	71.60	.1761	3.8	5.1	3.6							
39	1	7.11	38.07	13.29	11,029	7.2	7.80	37.30	17.07	10,442	15.52	.0464	.7	6.6	7.4	6.30	21.25	55.60	4,149	0	< .9	.3
	2						8.85	32.88	27.33	8,221	22.91	.1407	.2	3.1	5.0	5.03	26.72	46.75	6,338	0	< .9	1.7
	3						8.15	31.80	44.10	4,711	18.38	.1163	1.0	.2	.2							
40	1	5.44	39.11	11.32	11,623	7.4	6.00	36.80	17.78	10,535	6.52	.0209	.5	4.2	6.6	4.80	21.05	51.56	5,051	0	< .9	.5
	2						7.75	31.95	21.00	8,545	35.02	.1597	.3	1.2	.8	3.53	21.62	63.35	3,841	0	< .9	.5
	3						5.78	27.55	45.28	5,540	42.38	.0581	.2	.2	.3							
41	1	6.63	37.20	12.63	11,214	5.9	7.28	33.55	18.63	10,004	19.54	.0193	1.0	4.3	6.1	5.85	23.85	48.08	5,657	0	< .9	.5
	2										5.61	.0252	0	.7	3.3	5.50	26.70	42.25	6,647	.2	< .9	.9
	3						7.10	30.78	53.13	3,724	12.30	.0208	0	0	.2							
42	1	7.69	37.99	9.59	11,497	6.1					6.11	.0015	0	0	.2	4.30	21.50	48.60	6,048	0	> .9	.5
	2										1.51	.0006	0	.2	0	5.33	19.42	57.00	4,563	0	< .9	.5
	3							29.35		5,497	13.38	.0130	0	.2	.3							
Average		5.79	39.03	11.84	11,532	7.6	5.52	35.05	26.20	8,898	18.68				5.1	4.23	24.01	50.30	5,734			1.9

DISTRICT 5.

43	1	3.57	36.48	8.65	12,778	7.7	4.28	31.47	17.98	10,784	12.81	.0356	.2	3.8	6.3	3.40	30.35	19.69	10,431	0	1.4	6.8
	2						7.25	37.13	37.80	5,661	8.14	.0157	.2	.7	.3	1.93	24.82	37.45	8,446	0	1.1	5.4
	3						5.85	30.50	37.53	5,738	12.48	.0842	0	.3	.2							
44	1	3.28	36.43	8.81	12,691	7.3	2.50	34.90	20.48	10,879	11.74	.0124	.5	3.7	7.5	2.25	19.40	52.75	5,656	0	< .9	.5
	2						3.60	32.30	11.78	11,923	16.14	.0642	.7	6.1	8.2	1.55	16.30	61.55	5,116	0	< .9	.4
	3						3.15	27.03	37.28	6,968	14.70	.0254	.2	.2	.5							
45	1	3.41	36.17	8.30	12,706	7.2	3.90	28.40	24.20	9,437	22.91	.0584	.9	.7	.9	2.98	23.57	37.98	7,628	0	< .9	.7
	2						5.28	35.09	30.18	7,000	10.82	.0235	0	.2	.3	3.10	28.05	23.23	10,327	.2	1.4	4.0
	3						4.60	29.90	20.95	10,489	17.43	.1032	.2	3.1	5.2							
46	1	4.35	35.40	9.34	12,411	6.3	3.70	30.43	23.57	10,138	11.12	.0384	.9	3.1	5.1							
	2						4.18	28.37	35.28	7,524	13.29	.0356	.5	.5	.3							
	3						4.40	28.97	27.45	9,443	21.81	.0940	.5	1.0	3.9							
47	1	2.65	36.15	12.82	12,263	6.6	1.80	34.18	19.25	11,196	13.56	.0115	0	5.9	7.0	3.33	20.27	58.25	4,950	0	< .9	.3
	2						4.30	43.22	29.80	5,931	5.78	.0063	0	0	.2							
	3																					

TABLE 4.—*Combined data on face, rib-dust, and road-dust samples from mines in various Illinois districts*—Continued.

DISTR$CT 5—Continued.

Mine No.	Source of sample.	Face samples. Proximate analysis (air-dried sample). Moisture.	Face samples. Proximate analysis (air-dried sample). Volatile matter.	Face samples. Proximate analysis (air-dried sample). Ash.	Face samples. Proximate analysis (air-dried sample). Calorific value.	Face samples. Pressure at 1,200° C.	Rib-dust samples. Proximate analysis (air-dried sample). Moisture.	Rib-dust samples. Proximate analysis (air-dried sample). Volatile matter.	Rib-dust samples. Proximate analysis (air-dried sample). Ash.	Rib-dust samples. Proximate analysis (air-dried sample). Calorific value.	Rib-dust samples. Dust through a 200-mesh sieve.	Rib-dust samples. Dust per square foot through a 200-mesh sieve.	Rib-dust samples. Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Rib-dust samples. Pressure at 1,200° C. of— Dust through a 200-mesh sieve.	Rib-dust samples. Pressure at 1,200° C. of— Ground dust through a 200-mesh sieve.	Road-dust samples. Proximate analysis (air-dried sample). Moisture.	Road-dust samples. Proximate analysis (air-dried sample). Volatile matter.	Road-dust samples. Proximate analysis (air-dried sample). Ash.	Road-dust samples. Proximate analysis (air-dried sample). Calorific value.	Road-dust samples. Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Road-dust samples. Pressure at 1,200° C. of— Dust through a 200-mesh sieve.	Road-dust samples. Pressure at 1,200° C. of— Ground dust through a 200-mesh sieve.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		P. ct.	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*P. ct.*	*Ounces.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*P. ct.*	*P. ct.*	*P. ct.*	*B. t. u.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*
48..........	1	3.81	35.50	9.05	12,575	7.2	2.63	32.07	11.60	12,139	16.31	.0210	.5	2.1	7.2	2.63	20.17	49.88	6,329	......	......	1.2
	2	......	......	......	......	......	3.55	29.40	21.78	9,734	5.99	.0009	.2	.3	6.6	......	......	......	......	......	......	......
	3	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
49..........	1	2.77	38.50	11.40	12,343	7.2	......	......	......	......	26.56	.0467	0	2.9	5.6	2.5	31.87	24.20	10,089	.4	2.3	6.6
	2	......	......	......	......	......	6.20	34.15	30.50	6,961	15.26	.0153	0	.5	.3	2.3	21.32	52.02	6,145	0	< .9	1.9
	3	......	......	......	......	......	3.98	25.77	43.65	5,760	43.54	.1071	.2	.2	.3	......	......	......	......	......	......	......
Average	......	3.41	36.38	9.77	12,538	7.1	4.17	31.85	26.73	8,756	15.81	......	......	......	3.7	2.60	23.61	41.70	7,512	......	......	2.8

DISTRICT 6.

Mine No.	Source	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50..........	1	6.41	34.47	7.94	12,253	6.3	3.65	27.55	29.85	9,061	32.82	.0190	.7	.3	3.3	......	......	......	......	......	......	......
	2	......	......	......	......	......	5.15	32.10	25.25	9,144	7.87	.0004	0	.7	.7	......	......	......	......	......	......	......
	3	......	......	......	......	......	4.33	29.47	24.33	9,794	9.03	.0020	.2	1.2	5.4	......	......	......	......	......	......	......
51..........	1	4.44	35.24	7.70	12,555	5.8	4.31	28.61	21.97	10,300	11.83	.0266	......	......	.6	......	......	......	......	......	......	......
	2	......	......	......	......	......	4.03	38.56	32.26	8,075	19.00	.0775	......	......	.6	......	......	......	......	......	......	......
	3	......	......	......	......	......	4.37	30.17	25.35	9,430	56.26	.1249	......	......	.7	......	......	......	......	......	......	......
52..........	1	2.97	39.13	11.21	12,245	3.1	4.54	35.11	14.89	11,426	18.09	.0063	......	......	5.8	......	......	......	......	......	......	......
	2	......	......	......	......	......	3.19	38.61	18.50	11,018	23.29	.0095	......	......	6.6	......	......	......	......	......	......	......
	3	......	......	......	......	......	4.27	32.69	28.68	8,827	17.48	.0192	......	......	1.9	......	......	......	......	......	......	......
53..........	1	4.27	35.24	9.01	12,260	5.1	6.48	27.57	16.80	10,526	47.47	.1405	......	......	.7	6.64	29.92	17.71	10,726	......	......	1.7
	2	......	......	......	......	......	5.30	31.28	12.51	11,324	16.44	.0146	......	......	.9	5.36	28.24	24.43	9,868	......	......	1.0

	3						4.72	26.42	21.09	10,433	33.21	.1694			.9							
54	1	4.28	37.77	10.84	11,934	5.4	5.06	29.54	19.30	10,395	50.30	.0111			1.1							
	2						5.03	33.16	12.24	11,657	14.59	.0095			5.8							
	3						5.45	28.25	30.75	8,474	36.94	.0247			1.5							
55	1	3.48	36.37	10.90	12,154	6.5	4.78	32.24	18.40	9,967	24.59	.0492			.7							
	2						3.23	28.73	23.71	10,093	13.73	.0165			1.0							
	3						4.38	29.79	21.96	9,909	32.49	.0393			.7							
56	1	5.31	35.37	10.77	11,974	5.9	4.99	32.53	15.79	11,176	15.29	.0029			3.7	4.97	23.91	44.05	6,811			.3
	2						5.32	35.35	19.13	9,970	14.55	.0182			.9	5.18	31.32	22.92	10,166			2.1
	3						5.45	31.10	20.82	10,105	18.71	.0116			.8							
57	1	7.05	32.38	9.06	12,049	5.1	4.70	28.69	22.14	10,206	29.77				1.9	4.73	28.65	22.25	10,085			3.1
	2						4.81	30.59	22.07	10,123	28.44				5.8	3.95	26.27	29.17	9,331			4.5
	3										35.10				3.0							
58	1	4.02	37.16	8.35	12,483	6.7	4.05	30.34	24.46	9,857	18.26	.0095			.7							
	2						5.11	36.23	18.20	10,273	21.79	.0122			.9							
	3						4.90	31.42	21.37	10,229	33.99	.0299			1.3							
59	1	7.24	33.03	9.51	11,902	4.9	4.75	31.76	16.29	11,097	45.53	.0911			4.5	5.83	31.20	18.37	10,762	0	< .9	2.3
	2						5.35	29.36	20.50	10,229	50.52	.0354			.9	5.59	28.15	26.92	9,383	0	1.4	1.9
	3						4.32	26.31	41.33	6,851	59.60	.1573			.2							
60	1	3.87	35.37	9.52	12,346	5.4	4.21	31.10	12.32	11,718	22.18	.0073			3.3	7.02	31.42	14.03	10,931	.2	< .9	2.3
	2						5.55	30.91	16.99	10,166	49.16	.0462			.8	4.62	25.97	34.98	8,296			.7
	3						5.39	33.42	24.26	8,469	38.21	.0871			.5							
61	1	6.82	34.88	7.35	12,258	5.6																
	2																					
	3																					
62	1	6.79	33.86	8.08	12,159	4.9	4.42	26.15	37.38	7,864	76.72	.3007			.9							
	2						3.66	33.32	11.81	12,103	37.59	.0376			5.9							
	3						4.14	34.13	13.19	11,693	14.53	.0546			4.5							
63	1	5.39	32.91	9.45	12,222	5.7	3.74	33.30	14.50	11,509	30.74	.0267			5.4	5.33	34.08	16.93	10,895			6.3
	2						6.32	32.40	29.52	8,503	17.21	.0382			1.2	5.43	29.99	22.19	10,134			1.6
	3						6.20	38.11	34.63	7,306	41.18	.1091			.7							
64	1	5.31	37.26	8.73	12,299	7.9	3.13	30.65	12.95	12,004	22.40	.1035			2.6							
	2						5.41	32.76	16.87	9,817	15.08	.0700			.8							
	3																					
65	1	4.18	35.09	8.73	12,478	5.4	4.63	32.32	22.85	10,022	35.99	.0432			5.3	4.60	32.14	23.56	10,174	.5	4.4	5.2
	2						6.42	34.16	16.71	9,997	26.66	.0688			3.0	4.42	32.39	21.79	10,289	.2	< .9	4.2
	3						5.76	29.99	18.66	9,533	35.38	.0736			.9							
Average		5.11	35.35	9.20	12,223	5.9	4.77	31.54	21.46	10,017	29.55				2.2	5.26	29.55	24.24	9,846			2.6

DISTRICT 7.

66	1	7.90	40.20	10.87	11,209	8.0	4.45	38.85	11.43	11,542	11.47	.0253		7.7	8.7	4.05	32.50	28.05	8,467	.2	< .9	5.6
	2															3.13	33.92	23.32	10,049	0	3.9	6.8
	3						5.50	31.76	29.58	7,315	10.48	.0321	0	.2	1.0							
67	1	7.16	39.81	10.92	11,381	7.3	3.95	33.80	20.33	10,375	6.60	.0062	0	1.2	6.7	6.00	28.90	33.85	7,450	0	< .9	3.3
	2						7.33	34.38	35.58	6,754	26.38	.1131	.5	.5	.5	4.80	24.25	47.93	5,499	0	< .9	.5
	3						5.10	25.25	48.80	5,483	15.63	.1036	.2	.7	.5							
68	1	5.98	41.59	9.74	11,646	8.4	3.48	34.97	15.65	11,097	7.68	.0092	.2	1.6	7.9	7.58	34.22	29.65	7,643			2.3
	2						4.83	31.82	30.33	7,664	11.62	.0215	0	0	.9	5.08	30.52	31.50	8,240			5.6
	3																					

TABLE 4.—*Combined data on face, rib-dust, and road-dust samples from mines in various Illinois districts*—Continued.

DISTRICT 7—Continued.

Mine No.	Source of sample.	Face samples. Proximate analysis (air-dried sample). Moisture.	Face: Volatile matter.	Face: Ash.	Face: Calorific value.	Face: Pressure at 1,200° C.	Rib-dust samples. Proximate analysis (air-dried sample). Moisture.	Rib: Volatile matter.	Rib: Ash.	Rib: Calorific value.	Rib: Dust through a 200-mesh sieve.	Rib: Dust per square foot through a 200-mesh sieve.	Rib: Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Rib: Pressure: Dust through a 200-mesh sieve.	Rib: Pressure: Ground dust through a 200-mesh sieve.	Road-dust samples. Proximate analysis (air-dried sample). Moisture.	Road: Volatile matter.	Road: Ash.	Road: Calorific value.	Road: Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Road: Pressure: Dust through a 200-mesh sieve.	Road: Pressure: Ground dust through a 200-mesh sieve.
1	2	3	4	5	6	7	8	9	10	t11	t12	13	14	15	16	17	18	19	20	21	t22	t23
	P. ct.	P. ct.	P. ct.	P. ct.	B. t. u.	Lbs. per sq. in.	P. ct.	P. ct.	P. ct.	B. t. u.	P. ct.	Ounces.	Lbs. per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.	P. ct.	P. ct.	P. ct.	B. t. u.	Lbs. per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.
69	1	6.71	39.33	12.37	11,232	6.6	3.55	34.48	19.95	10,586	17.67	.0311	.3	4.2	6.8	4.60	20.10	55.73	4,671	0	< .9	.3
	2						5.75	32.33	24.08	8,609	21.86	.0265	1.0	3.2	1.0	4.33	24.87	45.37	6,343	.2	1.4	.9
	3						5.23	21.22	48.33	4,511	26.62	.1218	.2	.2	.3							
70	1	6.44	39.34	12.15	11,374	7.9	3.00	40.75	22.05	10,204	4.59	.0073	.3	5.8	7.9	4.90	27.05	49.03	5,020	0	< .9	.9
	2															4.38	27.52	42.35	6,514	.2	< .9	1.6
	3						10.53	31.57	35.33	5,179			0	.2	.3							
71	1	8.01	40.23	10.96	11,322	6.9	3.13	41.22	16.40	11,221	2.88	.0165	.3	4.5	8.7	4.13	29.02	39.40	6,809	0	6.2	2.1
	2						5.70	37.40	30.90	8,060	8.22		.2	.3	4.9	3.53	35.17	24.33	9,763			7.9
	3																					
72	1	8.95	40.18	10.50	11,164	5.9	3.70	36.50	15.35	11,007	6.27	.0010	0	5.6	9.3	4.70	21.40	59.50	3,913	0	< .9	.2
	2						5.23	36.82	16.80	10,262	5.86	.0158	.3	3.7	8.4	5.30	29.35	31.25	8,024	0	< .9	4.0
	3						6.80	35.38	26.90	7,619	10.05		0	.2	1.0							
73	1	7.93	40.74	9.08	11,527	6.8					2.44	.0044	.2	.3	7.2	5.25	22.80	58.45	4,221	0	< .9	.3
	2						4.25	33.75	19.55	10,253	10.22	.0187	.3	4.7	7.7	4.33	26.72	37.90	7,394	0	< .9	4.5
	3						6.50	35.05	29.08	7,592	12.26	.0254	0	.7	1.7							
74	1	8.44	39.61	10.83	11,122	5.8	3.65	38.90	16.48	10,870	8.23	.0121	.2	7.5	8.0	6.68	30.02	28.95	8,096	0	< .9	3.0
	2						5.50	36.30	40.00	6,309	2.55	.0108	0	.2	.3	7.18	31.07	28.30	7,792	0	< .9	3.8
	3						4.20	35.00	32.05	7,673	3.11	.0053	0	2.1	2.1							
75	1	5.94	40.66	10.16	11,691	7.7	4.85	35.63	17.83	10,508	16.39	.1210	.3	5.1	6.8	4.50	27.35	35.80	7,420	0	< .9	5.0
	2						8.00	33.00	22.60	8,075	28.69	.3032	.2	.2	2.8	3.35	28.10	38.82	7,731	.2	2.3	6.5
	3						6.18	32.42	20.28	9,385	40.73	.3381	.5	3.0	4.5							
76	1	6.22	39.94	11.69	11,534	6.8	4.10	35.78	19.43	10,514	7.31	.0282	.2	4.5	6.6	4.65	12.55	80.25	1,303	0	.9	.2
	2						5.73	32.95	18.13	10,328	11.22	.0188	0	1.2	8.6	4.05	30.35	31.70	8,674	0	1.4	6.3

	3						6.55	30.95	30.75	7,519	4.90	.0054	.2	0	3.0							
77	1						6.15	37.90	12.32	11,045	20.15	.1906	.3	6.6	8.4	4.63	28.62	40.87	6,973	0	< .9	5.2
	2						7.40	38.80	22.43	9,110	16.73	.0166	.3	5.1	6.1	4.23	27.57	38.64	7,472	0	< .9	4.7
	3						6.35	29.10	34.68	7,456	23.65	.0710	.2	0	.7							
78	1	4.40	41.16	12.45	11,666	8.7	3.63	34.59	25.13	9,508	5.42	.0119	0	4.6	7.7	5.03	18.67	59.58	4,054	0	< .9	.3
	2						3.30	33.05	18.93	10,672	9.61	.0191	0	.7	7.3							
	3						5.13	37.07	31.15	6,714	5.20	.0147	0	0	.3							
79	1	4.47	42.34	10.66	11,923	8.6	2.95	34.62	21.45	10,283	10.23	.0097	0	.7	6.8	3.48	22.97	57.90	4,720	0	2.3	.5
	2						3.58	36.57	22.22	9,983	7.10	.0099	.5	5.1	6.6	1.85	11.85	76.09	3,116			.3
	3						5.90	33.20	35.43	6,181	12.20	.0676	.0	.9	.3							
80	1	5.24	38.61	12.41	11,533	8.0	5.65	35.85	19.78	9,988	32.64	.1459	.5	4.2	5.9	5.72	29.58	36.45	7,621			4.0
	2						7.13	38.97	27.60	7,195	5.92	.0140	0	.2	1.0	5.05	32.48	28.25	9.081			6.2
	3																					
81	1	6.64	41.40	10.63	11,637	7.9	3.23	35.62	18.73	10,766	26.39	.0599	.7	5.4	7.9							
	2						4.35	35.80	26.50	8,885	21.30	.0541	.2	.2	3.0							
	3						5.23	30.27	34.25	7,160	18.09	.0301	.2	.2	.3							
82	1	5.28	41.12	11.60	11,700	7.3	2.73	37.70	24.70	9,850	7.81	.0118	.3	1.2	7.5							
	2						4.75	37.93	39.18	5,879	14.75	.0320	.2	.5	.4							
	3						6.25	39.28	39.55	4,990	12.73	.0593	0	0	.3							
83	1	5.81	38.94	12.12	11,399	7.0	6.68	34.27	42.30	5,182	17.67	.0518	0	.2	.3	5.85	29.80	33.08	7,970	0	1.4	4.4
	2						3.05	37.40	23.28	9,896	4.35	.0030	0	4.2	6.8	6.30	26.40	42.10	6,430	0	.9	1.2
	3						6.00	32.75	33.43	7,144	24.91	.1305	.2	.7	.9							
84	1	7.77	38.48	10.67	11,324	7.2	7.43	31.62	37.08	6,777			.2	.2	.7	4.20	30.35	32.67	8,314			5.9
	2																					
	3																					
85	1	8.43	37.53	10.31	11,313	5.9	7.85	32.40	21.43	9,148	40.35	.0783	.3	1.4	1.0	6.66	30.87	22.65	9,364	0	< .9	4.5
	2						8.98	31.75	24.47	8,262	44.23	.1101	.5	1.2	1.1	5.58	30.57	26.68	9,117			6.5
	3						7.10	33.93	29.08	8,267	17.14	.0351	.3	.5	1.2							
86	1	5.80	38.46	11.99	11,552	7.2	5.48	34.32	16.55	10,640	23.84	.0825	.3	5.6	6.2	5.48	34.32	16.55	10,610			
	2															4.25	28.30	35.25	8,231	2	< .9	5.8
	3						5.65	31.85	23.38	9,176	8.29	.0259	.2	.3	1.1							
87	1	6.66	35.67	11.58	11,466	6.8	5.43	37.32	24.65	9,563	4.91	.0055	0	2.8	4.5	5.45	26.00	38.68	6,709	0	< .9	.5
	2						8.23	35.87	23.25	8,354	16.65	.0388	.2	1.2	.7	4.23	32.12	26.69	9,497	0	1.4	5.4
	3																					
88	1	5.83	37.42	12.69	11,317	7.2	5.18	37.09	26.00	8,381	14.45	.0082	.2	1.4	2.3	4.73	35.42	21.25	10,359			6.8
	2						3.03	34.67	24.10	10,006	40.27	.0463	.2	4.7	6.5	4.55	29.73	29.90	8,937			4.7
	3						4.33	33.12	24.28	9,666			.3	4.2	7.0							
89	1	7.91	35.33	9.23	11,723	6.3	6.50	37.55	44.68	4,333	9.71	.0229	0	0	.2	2.93	17.57	65.90	3,757			.2
	2						5.55	32.30	21.30	9,563	10.26	.0097	.3	4.5	4.7	2.12	14.43	72.03	3,002			1.2
	3						4.25	32.55	20.68	10,147	14.98	.0144	.2	4.2	4.9							
90	1	6.40	36.50	10.88	11,479	6.8	4.35	34.85	20.28	10,071	16.52	.0388	.5	5.8	6.3	3.82	27.16	37.19	7,810			4.5
	2						4.55	37.15	16.95	10,712	7.66	.0214	0	5.8	6.6							
	3																					
Average		6.64	39.36	11.10	11,468	7.2	5.31	34.67	26.02	8,710	14.65				4.1	4.71	27.27	40.00	7,075			3.4

TABLE 4.—*Combined data on face, rib-dust, and road-dust samples from mines in various Illinois districts*—Continued.

DISTRICT 8.

Mine No.	Source of sample.	Face samples. Proximate analysis (air-dried sample). Moisture.	Face samples. Volatile matter.	Face samples. Ash.	Face samples. Calorific value.	Face samples. Pressure at 1,200° C.	Rib-dust samples. Proximate analysis (air-dried sample). Moisture.	Rib-dust. Volatile matter.	Rib-dust. Ash.	Rib-dust. Calorific value.	Rib-dust. Dust through a 200-mesh sieve.	Rib-dust. Dust per square foot through a 200-mesh sieve.	Rib-dust. Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Rib-dust. Pressure of— Dust through a 200-mesh sieve.	Rib-dust. Pressure of— Ground dust through a 200-mesh sieve.	Road-dust samples. Proximate analysis (air-dried sample). Moisture.	Road-dust. Volatile matter.	Road-dust. Ash.	Road-dust. Calorific value.	Road-dust. Pressure at 1,200° C. of— Dust through a 20-mesh sieve.	Road-dust. Pressure of— Dust through a 200-mesh sieve.	Road-dust. Pressure of— Ground dust through a 200-mesh sieve.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	P. ct.	P. ct.	P. ct.	P. ct.	B. t. u.	Lbs. per sq. in.	P. ct.	P. ct.	P. ct.	B. t. u.	P. ct.	Ounces.	Lbs. per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.	P. ct.	P. ct.	P. ct.	B. t. u.	Lbs. per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.
91	1	3.35	38.34	11.04	12,328	8.2	4.33	33.97	13.48	11,543	8.23	....	.5	1.7	6.8	4.70	25.10	37.78	7,693	0	.2	1.0
	2	......	......	......	......	......	5.65	26.05	48.00	6,008	28.58	....	.3	.3	.3	4.90	24.13	43.10	6,943	0	.2	1.4
	3	......	......	......	......	......	6.28	27.12	36.95	7,418	21.72	....	.3	.3	.5	......	......	......	......	......	......	......
92	1	4.42	36.72	12.36	11,939	8.0	6.23	30.87	15.53	11,027	8.86	....	.2	.3	4.7	4.48	22.65	43.00	6,953	0	.2	1.6
	2	......	......	......	......	......	5.65	30.75	15.80	11,068	10.82	....	.3	.5	3.3	5.00	25.58	38.83	7,306	0	.1	.3
	3	......	......	......	......	......	5.58	25.92	48.55	5,555	24.00	....	.2	.2	.2	......	......	......	......	......	......	......
93	1	5.39	38.67	9.33	12,221	8.2	4.63	37.17	11.58	11,774	17.64	....	.2	3.2	6.3	3.28	18.02	60.18	4,622	0	0	.2
	2	......	......	......	......	......	6.33	29.67	35.93	7,571	32.33	....	.2	.2	.7	2.73	20.10	61.43	4,437	0	0	.3
	3	......	......	......	......	......	6.07	29.23	29.85	8,741	19.41	....	.3	.5	1.9	......	......	......	......	......	......	......
94	1	3.12	43.01	10.31	12,517	9.8	......	......	......	......	......	....	......	......	......	......	......	......	......	......	......	......
	2	......	......	......	......	......	......	......	......	......	......	....	......	......	......	......	......	......	......	......	......	......
	3	......	......	......	......	......	......	......	......	......	......	....	......	......	......	......	......	......	......	......	......	......
95	1	5.08	43.13	9.61	12,232	10.1	......	......	......	......	37.32	....	......	......	6.6	5.15	12.48	78.63	1,693	0	0	0
	2	......	......	......	......	......	......	......	......	......	45.01	....	......	......	5.8	......	......	......	......	......	......	......
	3	......	......	......	......	......	......	......	......	......	......	....	......	......	......	......	......	......	......	......	......	......
97	1	2.85	41.45	12.19	12,155	9.1	......	......	......	......	2.63	....	......	......	6.1	4.03	18.25	58.78	4,759	0	0	.2
	2	......	......	......	......	......	......	......	......	......	10.73	....	......	......	7.5	3.55	22.30	48.40	6,235	0	.2	.7
	3	......	......	......	......	......	......	......	......	......	4.39	....	......	......	0	......	......	......	......	......	......	......
Average	......	4.03	40.22	10.81	12,232	8.9	5.64	30.08	28.41	8,967	19.40	....	.3	.8	3.6	4.20	20.96	52.24	5,627	0	.1	.6

MINES NOT INCLUDED IN DISTRICTS.

99	1	4.03	39.85	8.84	12,476	8.9																
	2																					
	3																					
100	1	3.55	42.30	10.85	12,361	8.2					8.53	.0068	.2	1.9	6.5	2.85	15.05	79.35	1,006	0	<.9	0
	2						5.90	21.85	70.08	1,345	5.83	.0038	0	0	0	3.35	20.85	61.95	3,548	0	<.9	.2
	3							22.30			2.98		.2	.5	.3							
100	1	3.59	38.96	14.76	11,612	8.4																
	2																					
	3																					
Extra	1	2.75	38.68	12.54	12,317	7.9																
	2																					
	3																					
P. S. D.[a]		2.70	36.00	6.30	14,400	9.1																

[a] Pittsburgh standard dust.

DISTRICT 1.

District 1 includes Bureau, Grundy, La Salle, Livingston, Marshall, Putnam, and Will Counties, and part of Woodford County. The No. 2 seam is worked in the district. The coal is highly inflammable, the average pressure, 8.4 pounds, being with one exception the highest developed in the samples from the eight districts. The average volatile-matter content, 40.66 per cent, of the face samples is higher than that of any other district.

All of the so-called "room samples" of rib dust were brushed from the fresh working face, and consisted therefore, probably, for the most part of freshly formed dust. Most of the dusts when ground to pass a 200-mesh sieve proved to be only slightly less inflammable than the face samples, and only one of them developed a pressure of less than 0.5 pound. The 200-mesh parts of each of the original rib-dust samples—that is, the part of the sample that passed a 200-mesh sieve—on the average developed somewhat less pressure than similar samples from other districts. One-half of them developed a pressure of less than 0.5 pound. None of the 20-mesh samples developed a pressure of more than 0.2 pound. Compared with other districts, the unground parts of the room samples of rib dust were decidedly less inflammable. This difference may in part be due to the smaller proportion of fine dust particles in the samples from district 1. The proportion of dust in room samples of rib dust fine enough to pass a 200-mesh screen averaged, in district 1, 5.96 per cent, whereas the average for other districts ranged from 10.8 to 13.4 per cent, and in one district was as high as 31.8 per cent.

As one should expect from the method of mining (long-wall) employed in district 1, the dusts collected in the haulageways there were high in ash, and most of them did not ignite in the inflammability apparatus. None of the 200-mesh portions of the original rib-dust samples from the entries developed a pressure of more than 0.2 pound, two of the ground samples developed relatively high pressures, one ground sample developed a pressure of 0.2 pound, and the remaining samples produced no pressure.

The average ash content of the road-dust samples was about 10 per cent lower than that of the rib dusts from the entries, and a greater proportion of them developed appreciable pressures in the inflammability apparatus. About one-third of the ground road-dust samples developed pressures greater than 0.5 pound. The inflammability of the road dust of this district is doubtless due to coal that falls from the car, as no coal is in place along the entries. A blown-out shot or a gas explosion in a mine would presumably act on both rib dust and road dust, and therefore these dusts must be considered collectively. As, in 50 years of working, an explosion other than a pocket of gas has never been reported from the Illinois long-wall

field, the presumption is that the entries do not contain enough inflammable dust to present the dangers of propagating an explosion.

DISTRICT 2.

District 2 includes Jackson County, where the No. 2 seam is worked. Rib and road dusts were sampled in four mines in the district, and face samples were obtained from five mines. The average content of volatile matter for the five mines was 34.25 per cent, which was lower than that of any other district. The inflammability of the face samples was also the lowest of the eight districts, the average pressure at 1,200° C. being 5.8 pounds.

The samples of rib dusts from the rooms and secondary haulageways of all four mines were highly inflammable. Only two rib dusts from main haulageways were studied and both of these developed low pressures. Of the six road dusts tested, two from secondary haulageways and one from a main entry were highly inflammable; a fourth developed a pressure of 0.5 pound, and two developed pressures less than 0.5 pound.

DISTRICT 3.

District 3 includes Brown, Calhoun, Cass, Fulton, Greene, Hancock, Henry, Jersey, Knox, McDonough, Mercer, Morgan, Rock Island, Schuyler, Scott, and Warren Counties. Seams 1 and 2 are worked in the district.

So far as face samples were concerned, district 3 stood second in the content of volatile matter, the average value for the five mines sampled being 40.39 per cent. The samples of the district were third in relative inflammability.

All of the rib dusts studied, which were limited to samples from the rooms and minor entries, were decidedly inflammable. The road dusts were high in ash and relatively low in inflammability. Out of six samples four developed a pressure of 0.5 pound or more. None of them produced a pressure higher than 1 pound.

Although the rib dusts of this district are unusually inflammable, the road dusts contain a large proportion of inert material and are much less inflammable than those of other parts of the State. As the mines are near the surface, the dusts are wet and therefore in their present condition not dangerous.

DISTRICT 4.

District 4 embraces Dewitt, Fulton, Logan, Macon, Mason, McLean, Menard, Peoria, and Tazewell Counties, and parts of Sangamon and Woodford Counties. No. 5 seam is worked.

The face and the rib-dust samples of district 4 were nearly identical in composition and inflammability with those from district 3. All of the rib dusts from the rooms and secondary entries except those

from mine 42 developed pressures of 0.5 pound or more. With few exceptions the pressures were high. The average pressure for all rib-dust samples, including those from the main entries, was 5.1 pounds.

Most of the road dusts from district 4, unlike those from district 3, were decidedly inflammable. Eighty per cent of the road dusts developed pressures of 0.5 pound or more.

In 1915 an explosion occurred at one of the mines in the district, the flame traveling a distance of 1,000 to 1,200 feet from the origin, being extinguished when it reached the main haulage road.

DISTRICT 5.

District 5 includes Gallatin and Saline Counties, and the district embraces seven mines. Seam No. 5 is worked. According to the tests of the face samples the coal of this district is somewhat below the average of the coal of the State in volatile matter and slightly below the average in inflammability. About two-thirds of the rib dusts developed pressures of 0.5 pound or more. Eighty per cent of the samples of road dusts were found to be inflammable when ground to 200-mesh size. Five out of nine of the 200-mesh parts developed pressures greater than 1 pound.

DISTRICT 6.

District 6 includes Franklin County and parts of Jackson, Perry, and Williamson Counties. Seam 6, east of Duquoin anticline, is worked.

The coal from district 6 is relatively low in inflammability, as well as in the content of volatile matter, the average values being a pressure of 5.9 pounds and a volatile-matter content of 35.35 per cent.

The inflammability of the samples of mine dusts from the district was exceptionally high. Out of 44 samples of rib dust tested, all but one developed a pressure of 0.5 pound and more. Thirteen out of 14 road dusts produced pressures in excess of 0.5 pound. The ash content of the mine dusts was unusually low, the average values being 21.46 per cent for the rib dusts and 24.24 per cent for the road dusts. The practice in the district is to leave the top coal for roof, so that a low ash content in the dusts is to be expected.

The proportion of inflammable rib and road dusts is greater in district 6 than in the mines of any other part of the State. In this connection attention is called to the high proportion of fine dust in the rib dusts from this district. An average of 30 per cent of the samples of rib dust passed through a 200-mesh screen. The proportion of fine dust actually present in the mines is probably greater than 30 per cent, because, on account of the high velocity of the ventilating currents in the district, part of the finest dust was lost in

sampling. That the mine dusts of the district are of a dangerous character is confirmed by the fact that in 1914 an extensive and disastrous explosion occurred in one of the mines of the district.

DISTRICT 7.

District 7 includes Bond, Christian, Clinton, Fayette, Macoupin, Madison, Marion, Montgomery, Moultrie, Perry, Randolph, St. Clair, Shelby, and Washington Counties, and part of Sangamon County. Seam 6, west of the Duquoin anticline, is worked.

The face samples from the district showed about the average inflammability. The content of volatile matter was somewhat higher than the average, and the calorific value somewhat lower than the average for the eight districts. Most of the samples of rib and road dusts developed high pressures. However, a larger proportion of dusts giving a pressure less than 0.5 pound was found in district 7 than in district 6. In district 7, 84 per cent of the rib dusts and practically the same percentage of the road dusts developed a pressure of 0.5 pound or more.

DISTRICT 8.

District 8 includes Edgar and Vermilion Counties. Seams 6 and 7 are worked in the district.

The inflammability of the face samples was higher than that of the samples from any other district, the average pressure being 8.9 pounds. The average content of volatile matter was 40.22 per cent.

Three-fourths of the ground rib dusts developed a pressure of 0.5 pound or more, and most of these developed relatively high pressures, and under favorable conditions would have given rise to explosions. The road-dust samples of the district had an average ash content of 52 per cent, and were less inflammable than those of any other district. Out of nine ground samples four developed a pressure greater than 0.5 pound, and the average pressure for the samples from the district was 0.6 pound. None of the 20-mesh samples developed any measurable pressure, and none of the 200-mesh parts of the unground samples developed a pressure greater than 0.2 pound.

A graphic comparison of the relative inflammability of the dusts from the different districts is given in figures 16 to 22. Figure 16 comprises a map of Illinois on which each mine included in the cooperative investigation is represented by a symbol showing the magnitude of the pressure developed by the face sample with a coil temperature of 1,200° C. Figures 17 to 19 show the pressures developed by the rib dusts, and figures 20 and 21 show the pressures developed by the road dusts.

FIGURE 16.—Map of Illinois showing relative inflammability of face samples.

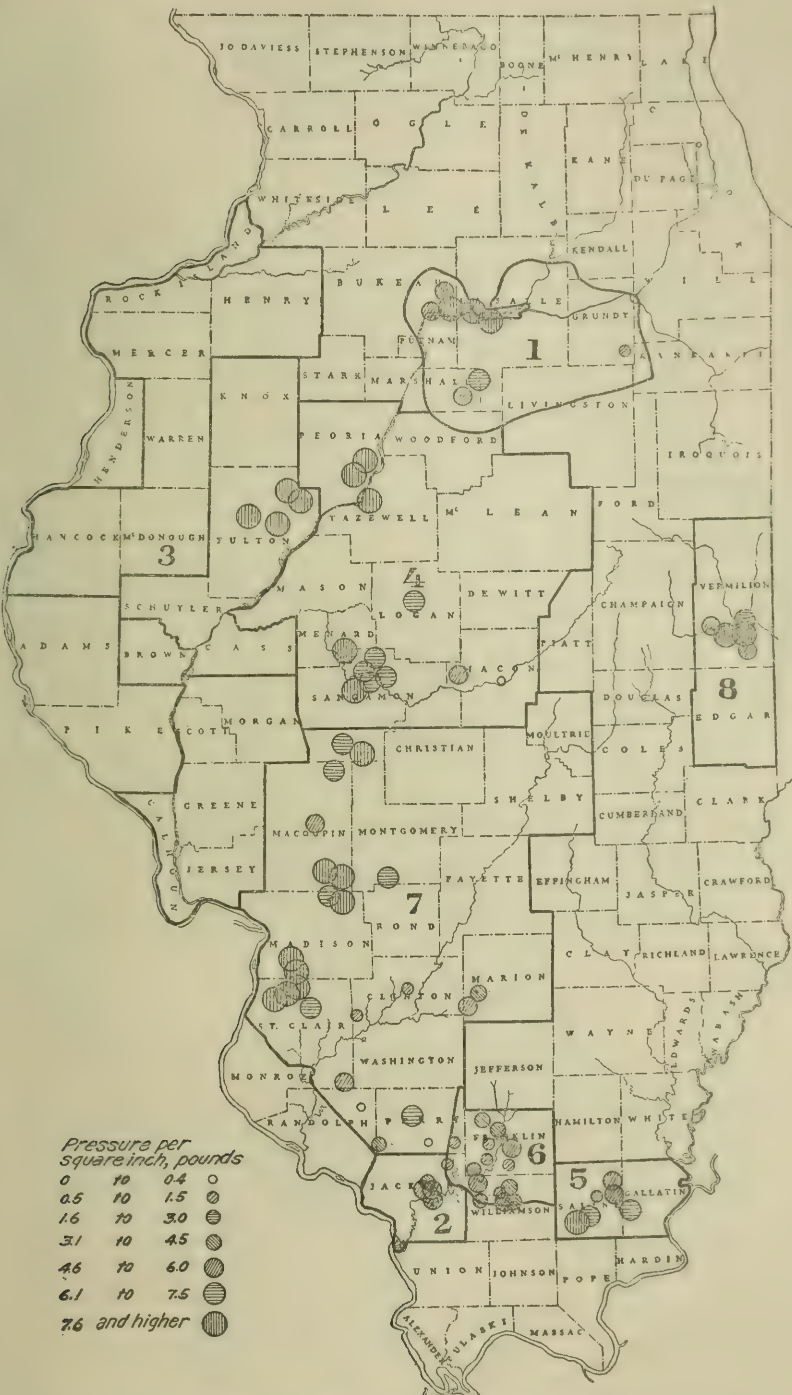


FIGURE 17.—Map of Illinois showing relative inflammability of rib dusts from rooms.

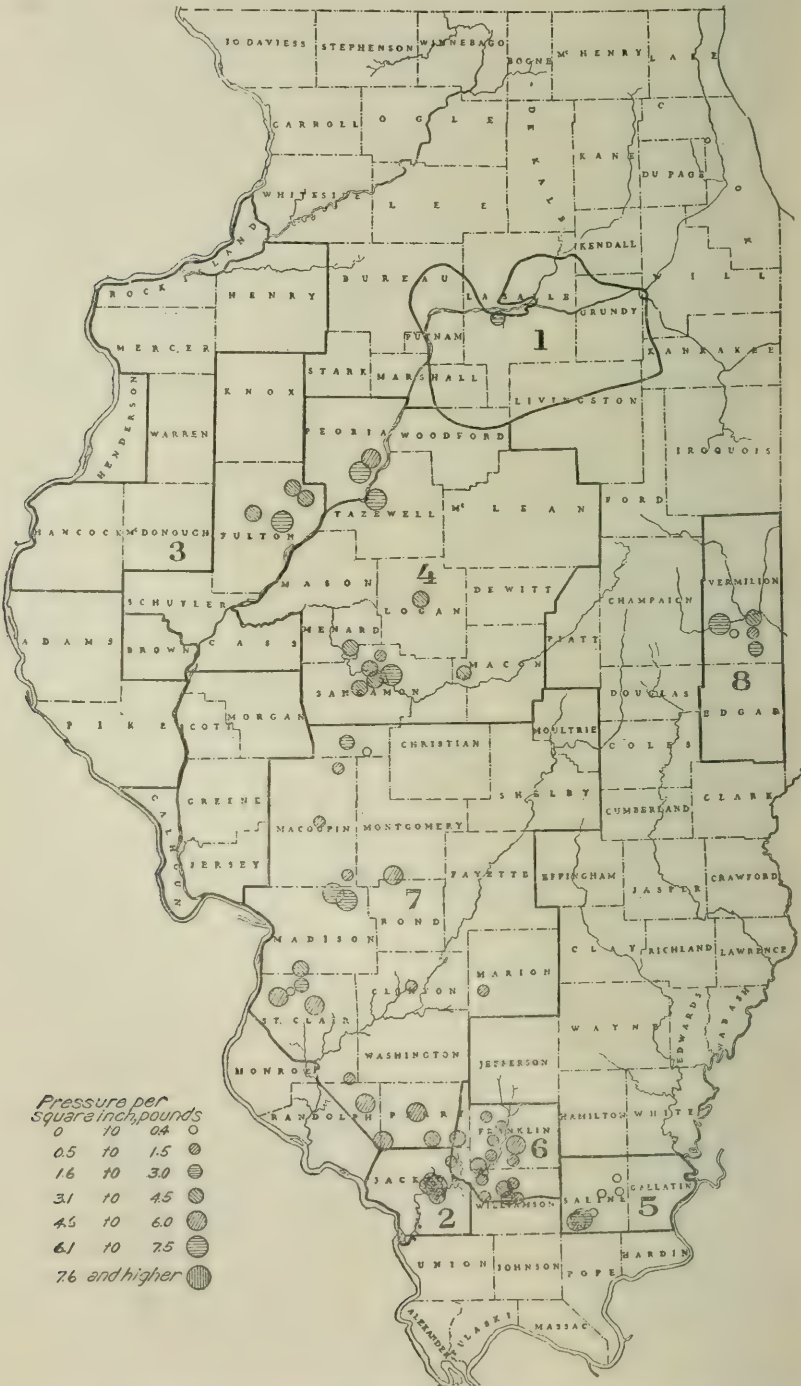


FIGURE 18.—Map of Illinois showing relative inflammability of rib dusts from secondary haulage roads.

FIGURE 19.—Map of Illinois showing relative inflammability of rib dusts from main haulage roads.

FIGURE 20.—Map of Illinois showing relative inflammability of road dusts from secondary haulage roads.

FIGURE 21.—Map of Illinois showing relative inflammability of road dusts from main haulage roads.

RELATION OF INFLAMMABILITY TO CHEMICAL COMPOSITON OF COAL DUST.

The inflammability of coal dust, that is, the readiness with which a cloud of dust inflames, depends on the chemical and physical properties of the dust. For example, the finer the dust particles the more readily inflammable will be the cloud. The greater the content of inert material, as ash and moisture, the lower will be the inflammability. The volatile matter of a given coal has an important bearing on its inflammability. Taffanel,[a] in his gallery tests at Liévin, France, found that the greater the content of volatile matter the more inflammable was the dust. From laboratory tests on a number of coals differing widely in volatile-matter content, the same author [b] found that "the various coals tested, fineness and purity being equal, are approximately classified in the order of their content of volatile matter."

The British explosions in mines committee [c] concluded from laboratory inflammability tests that "the relative inflammability does not depend upon the 'total volatile matter,' but on the relative ease with which inflammable gases are evolved. The order of inflammability so obtained [by their laboratory method] corresponds in a remarkable degree with the percentage of inflammable matter extracted from the same coals by pyridine."

Although the Illinois coals are all of the same type, the data from the unusually large number of samples tested offer an exceptional opportunity for studying the relation between inflammability and chemical composition. In order to determine whether a quantitative relation could be established between inflammability and the volatile matter, the ash, and the calorific values of the face samples, it was assumed that the relation may be expressed by the equation—

$$P=A+B\times\text{volatile matter}-C\times\text{ash}+D\times\text{B. t. u.}$$

in which P is the pressure developed in the inflammability tests with a coil temperature of 1,200° C., and A, B, C, and D are constants. The values of these constants were calculated by the method of least squares from the results obtained for 50 samples selected at random. The agreement between observed values of P and values calculated by means of the equation thus obtained is not satisfactory.

The relation between inflammability and volatile-matter content of the face samples is shown in figure 22. The various symbols used to designate the points show the districts from which the

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[a] Taffanel, J., Troisième série d'essais sur les inflammations de poussières; production des coups de poussières, 1910, p. 397.

[b] Taffanel, J., and Durr, A., Cinquième série d'essais sur les inflammations de poussières: Essais d'inflammabilité, 1911, p. 46.

[c] Second Report to the Right Honorable the Secretary of State for the Home Department of the Explosions in Mines Committee, 1912, p. 17.

samples were taken. No definite relation between inflammability and volatile-matter content is shown. There is, however, a decided tendency for the inflammability to increase as the percentage of volatile matter increases.

TESTS OF INFLAMMABILITY OF ROAD DUSTS BY MODIFIED METHOD.

As previously stated, subsequent to the completion of the greater part of the experiments with Illinois dusts it was found that dusts that developed no measurable pressure in the laboratory apparatus were capable of propagating an explosion in the experimental mine of the Bureau of Mines. The laboratory apparatus and method were therefore modified.

Road dusts from district 8 were sampled after the change in the laboratory had been made, and portions of the samples, ground to 200-mesh fineness, were sent to the Pittsburgh laboratory and tested by the new method. The pressure figures obtained by both methods are given in the following table:

Results of inflammability tests of road dusts from district 8, by modified method, samples ground to 200-mesh fineness.

Mine number.	Sample number.	Inflammability pressure by—			Group.
		Regular method.	Modified method.		
		Coil temperature, 1,200° C.	Tube temperature, 1,100° C.	Tube temperature, 1,200° C.	
		Lbs. per sq. in.	*Lbs. per sq. in.*	*Lbs. per sq. in.*	
92	1	1.6	7.3	....	1
91	2	1.4	7.3	....	1
91	1	1.0	7.4	....	1
97	2	.7	7.6	....	1
97	1	.2	.4	4.3	2
92	2	.3	1.7	....	1
93	2	.3	1.3	....	1
93	1	.2	.4	4.5	[illegible]
95	1	.0	.2	.7	3

With the new or "modified" method, dusts may be classified according to their inflammability into three groups. Group 1 includes all dusts that can be ignited by a blown-out shot and give rise to an explosion. Group 2 includes dusts that can not be ignited by a blown-out shot and give rise to an explosion, but may propagate an explosion that has originated in a more inflammable dust or in an inflammable gas mixture. Group 3 includes dusts that will not propagate an explosion.

The numbers in the last column of the table show the groups to which the road dusts of district 8 belong. Six of them would give

rise to an explosion if properly ignited, and all but one would propagate an explosion.

PREVENTIVE MEASURES.

For several years investigations dealing with the prevention and arresting of dust explosions have been conducted under the direction of George S. Rice, chief mining engineer of the Bureau of Mines, and are not yet concluded. As a result of the experiments a number of recommendations have been made regarding the measures to be

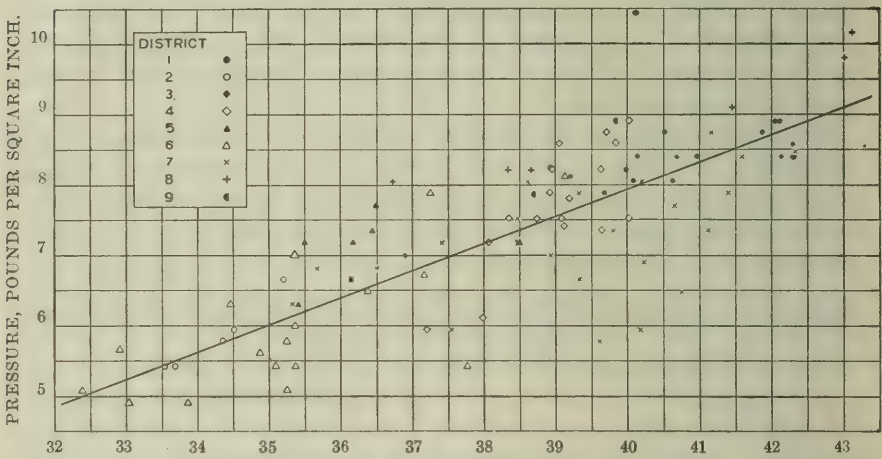

FIGURE 22.—Relation between volatile matter and inflammability of face samples.

adopted for guarding against dust explosions. Some of them have been stated in publications of the bureau [a] and others will be announced as investigations progress.

[a] Rice, G. S., What a miner can do to prevent explosions of gas and of coal dust: Miners' Circular 21, Bureau of Mines, 1915, 24 pp.; Rice, G. S., and Jones, L. M., Methods of preventing and checking explosions in coal mines: Tech. Paper 84, Bureau of Mines, 1915, 50 pp.; Williams, R. Y., The humidity of mine air with special reference to coal mines in Illinois: Bull. 83, Bureau of Mines, 1914, 69 pp.; Rice, G. S., Notes on the prevention of dust and gas explosions in coal mines: Tech. Paper 56, Bureau of Mines, 1913, 24 pp.; Munroe, C. E., and Hall, Clarence, A primer on explosives for coal miners: Bull. 17, Bureau of Mines, 1911, 61 pp.; Rice, G. S., and others, The explosibility of coal dust: Bull. 20, Bureau of Mines, 1911, 204 pp.

PUBLICATIONS ON MINE ACCIDENTS AND METHODS OF COAL MINING.

Limited editions of the following Bureau of Mines publications are temporarily available for free distribution. Requests for all publications can not be granted, and applicants should select only those publications that are of especial interest to them. All requests for publications should be addressed to the Director, Bureau of Mines, Washington, D. C.:

BULLETIN 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 61 pp., 10 pls., 12 figs. Reprint of United States Geological Survey Bulletin 423.

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